POPULAR SCIENCE

FOUNDED MONTHLY 1872

JUNE

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OCEAN MARVELS SEEN FROM UNDERWATER BUS

Page 57

$10,000 in Cash Prizes

SEE PAGE 32

CHANGE SPARK PLUGS EVERY 10,000 MILES FOR BETTER ENGINE PERFORMANCE

CHAMPION

NATIONAL CHANGE WEEK - May 9 to 16

The Champion Spark Plug Tester, shown above, enables you to see why and when you need new spark plugs.

① Note scientifically proportioned nose

② Note scientifically proportioned neck

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ALL-STEEL REFRIGERATOR

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Popular Science Monthly for June, 1932

NEW DEVICES FOR THE HOME

NEW PROCESSES AND INVENTIONS

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UNUSUAL FACTS AND IDEAS

FOR THE HOME OWNER

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IDEAS FOR THE HANDY MAN

HINTS FOR THE MECHANIC

Nation's BILLIONS NOW *Behind the Banks*

By LEON MEADOW, *Financial Editor*

A LETTER received by the Financial Department the day before this was written seems so well timed in the light of present conditions, that we are publishing our answer in the form of this article, which we believe will be of interest to all our readers as well as the one who wrote this letter:

> Financial Editor,
> Popular Science Monthly,
> 381 Fourth Avenue, N. Y. C.
>
> Dear Sir:
>
> Read with interest your article in the May issue on Hoarding. There must be many thousands of people afraid to keep their money in banks.
>
> Recently newspapers hailed the Glass-Steagall Bill with great enthusiasm. Though not thoroughly versed in financial matters, I did draw the general conclusion from these reports that this Bill would lessen the possibility of the average bank having to suspend operation because too many of its assets were "frozen" in character—although the bank is actually solvent.
>
> Would you have any facts which might show if this law has done anything to improve public confidence—either by halting the suspension of banks, or by reducing the number of banks in difficulty—and perhaps through no great fault of their own?
>
> Sincerely yours,
> Willis Austin, Queens, L. I., N. Y.

Mr. Austin raises an interesting question. Certain measures recently devised by the Government to protect and help solvent banks in distress have been unusually effective in a short time. One, as he mentions, is the Glass-Steagall Bill. The other is the organization of the Reconstruction Finance Corporation—now in full operation.

Don't let the continued low level of business conditions blind you to the fact that *immense* improvement has taken place in our banking system—and that that improvement, in turn, is instrumental in bringing back that all-important factor, "confidence," which must necessarily precede any general business improvement.

During the last two years a great many banks have been forced to close their doors. In normal years, the total of such suspensions, usually due to inefficient management, is well below 1000. In 1926, a relatively poor business year, about 960 banks were forced to suspend operations—and that figure was the highest for the nine year period from 1921 to 1929. But in 1930 the total jumped to 1,345—and in 1931 to no less than 2,290. No wonder a near panic among bank depositors ensued—which, unfortunately, lead to further embarrassments.

The irony of it was that most of these suspended banks were solvent—although not in liquid condition—and shouldn't have gone down at all. They were solvent because their assets more than offset their liabilities—but the difficulty in most cases arose from the fact that a large proportion of these assets could not be liquidated. They were frozen in real estate, in commercial loans, or in practically unsaleable collateral securities. Of course a bank's assets should be in as liquid a state as possible, and must be able to meet even more than a normal withdrawal of deposits. But, in these abnormal times, the average bank had become even *less* liquid than usual, and was faced with an even larger withdrawal of cash. This was the heart of the problem—and the Government clearly realized the importance of immediately remedying this situation.

THROUGH the Glass-Steagall Credit Expansion Bill it has provided several measures, in some of which are permanent, others temporary, but all designed to increase the borrowing power of banks in needy circumstances. In other words, such banks, if the emergency should arise, will be in a position to raise much more easily and quickly than otherwise the cash required to meet the demands of its depositors. At the same time, this excellent law has removed the cause for fear, if at any future time large withdrawals of gold should take place again by foreign countries. The Bill has done this by releasing the surplus gold above the 40% required by law to support outstanding note issues (currency in circulation). It is calculated that some $700,000,000 more gold can now be shipped out of the country than under the previous law without impairing our legal gold status. Although this seems almost superfluous in view of the already enormous oversupply of gold holdings in this country, nevertheless this measure means an added safety factor.

The Reconstruction Finance Corporation, now in actual operation, has been formed to make loans to financial institutions, etc. which are eligible to relief. This field is broader than that of banks alone, including for example, railroads—and also explicitly mentioning in its provisions "National and State Banks, Savings Banks, Trust Companies and Building and Loan Associations," who, under certain conditions, can apply to the Corporation for financial aid in the form of loans.

Aided by these two measures—the Glass-Steagall Bill and the Reconstruction Finance Corporation—banks which are intrinsically solvent, should no longer face

NATION'S BILLIONS NOW BEHIND THE BANKS

the necessity of closing their doors as a result of a temporary run on their cash resources by unduly frightened depositors.

We mentioned before that these measures have proved unusually effective in the very short time they have been in operation—and here is proof of that statement:

There were 353 bank suspensions during December, 1931. During January, 1932, they numbered 372, and then fell off during February to 128. But, for the *four weeks* ending March 24th, they dropped to a total of only 31. For the third week in this period they numbered only 10, for the fourth week, only 7. And in this last week, six banks reopened—so that the net loss for the period was only one bank! These figures tell their own story, and testify to the very material improvement that is noticeable in the all-important banking situation of this country.

We should like to point out to Mr. Austin, and to our other interested readers, the significance of this improvement. Depositors can again take a sane attitude toward the banks. Hoarding, which is never sensible, is now less sensible than ever. Normal credit channels are again opened up, to take care of the needs of deserving enterprises and business men. To sum it all up—it means that a firm foundation has been laid to restore public confidence and to prepare the way for a gradual, although possibly slow, building up of better business conditions, increased employment and greater material welfare for our entire country in general.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

The Investment Aspect of Life Insurance, by M. A. Linton, presents life insurance as an exceedingly worth-while investment as well as a form of protection. Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate Plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

Booklets, Samples, Information, Available To Popular Science Readers

By referring to the advertisements on the pages indicated below, you can solve a great many problems. Most of the advertisers in Popular Science Monthly offer valuable catalogues of tools, or booklets of information and instruction. Others will send you samples of products ranging all the way from shaving cream, to glue, and tobacco. We recommend these advertisers to you. There is so much real information in their announcements in this magazine that readers of Popular Science Monthly will find them not only interesting but decidedly helpful as an index of the most modern and practical devices and developments.

Popular Science GUARANTEE

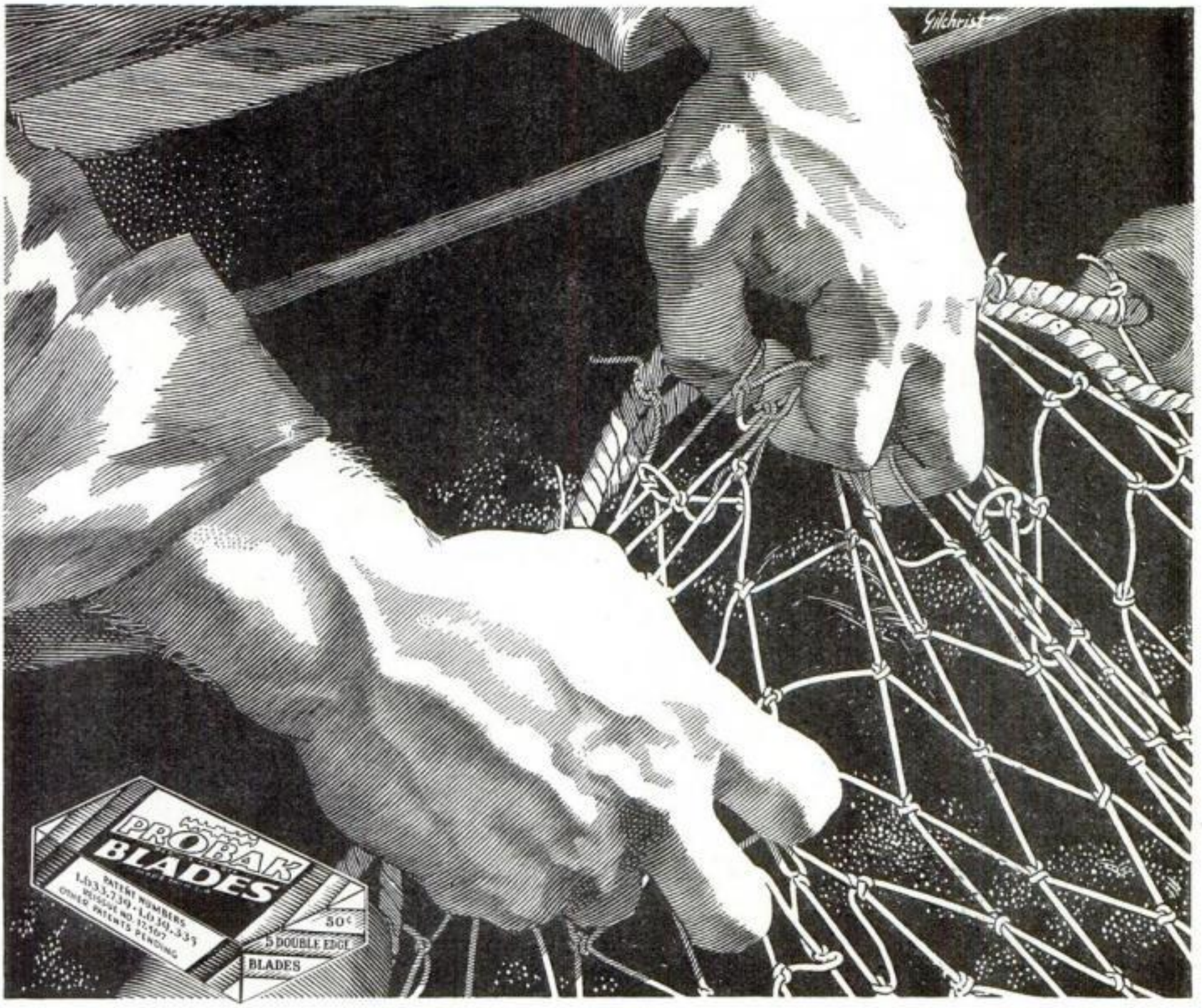
POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, and Oil Burners advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

THE BLADE FOR MEN THAT *ARE* MEN



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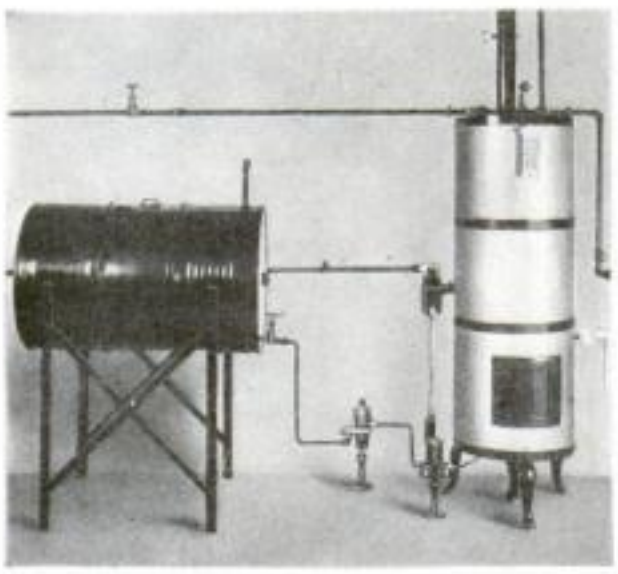
PROBAK BLADES

THE BLADE FOR MEN THAT *ARE* MEN

OIL HEAT *for Every Purpose*

This easily operated oil burner has been installed in coal burning kitchen range, and is as convenient as a gas stove



Automatic water heater with thermostatic controlled oil burner

Above, a hand operated oil burning hot water heater and at left, oil room heater

By R. M. Bolen

Secretary, Popular Science Institute

NO LONGER are the comforts and convenience of oil heat confined to the main heating system of an expensive home. Small, economical oil burning units now available from a number of manufacturers make it possible for the owner of a small home, the summer cottager, and the rural resident to enjoy the benefits and ease of control of this modern fuel.

Operating on the principle of natural draft domestic burners, these compact units vaporize light furnace oil by their own heat and burn the resulting gas with a clear blue flame containing the maximum of heat with the minimum of dirt and soot. A small valve lever controls the flame so that a wide range of temperatures is available. Single burners, under average conditions, have been operated for as little as one cent an hour.

So flexible are these small burners that they can be installed easily in existing coal or wood heaters and gas- or coal-fired hot water heaters, giving finger-tip control of heat and hot water without ashes, coal scuttles, and wood piles. Units of this type are also manufactured for installation in wood and coal burning kitchen ranges, where they give clean, simple, and safe service, comparable to that of a modern gas stove.

The home owner who already has a large domestic oil burner can use these units, combined with artistically designed heater cabinets, to heat a sun parlor, an attic room, or any other portion of the house not supplied with adequate heating facilities. To the summer cottager, these units offer a ready means of obtaining heat and hot water.

Large automatic oil burning hot water heaters are also available. Like gas-fired heaters, these units are entirely automatic, being controlled by a fool-proof thermostat that insures hot water at all times. Hot water heaters of this type can be obtained in the power-driven and natural draft types, the only requirement being that electricity be available. Separate automatic units can also be installed in gas-fired water heaters. Installations have shown lower operating costs than is possible with any other automatic method of heating water.

The comforts and convenience of these oil-fired burners compare only in a small way, however, with the fully automatic domestic oil burners for main heating plants. These large burners, available for installation in regular furnaces or as a complete unit, remove the human equation from the heating problem. Delicate thermostats, sensitive to the slightest temperature change, control the burners so that an even temperature is maintained. Besides the convenience of it, it can be readily seen that such a system promotes efficient fuel consumption, since the burner operates only when the temperature drops below the desired level.

Those readers who desire further information regarding small burners for heater or stove use or the large domestic heating plant burners can obtain it by writing to the Popular Science Institute, 381 Fourth Avenue, New York, N. Y.

INSTITUTE BULLETINS

Heating and Ventilating*
Insulation in Building Construction*
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List of Approved Radio Sets
List of Approved Oil Burners

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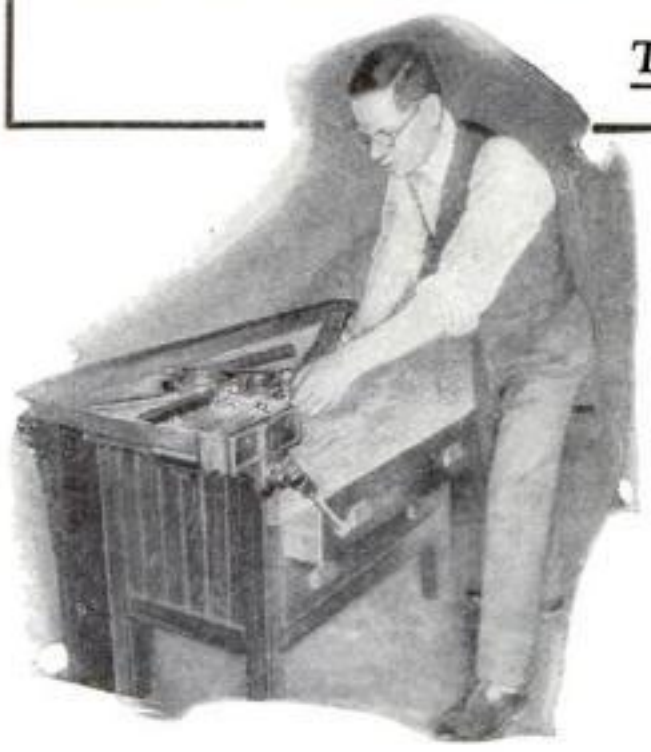
Those Who Buy in Dull Times Are Entitled to a Bargain



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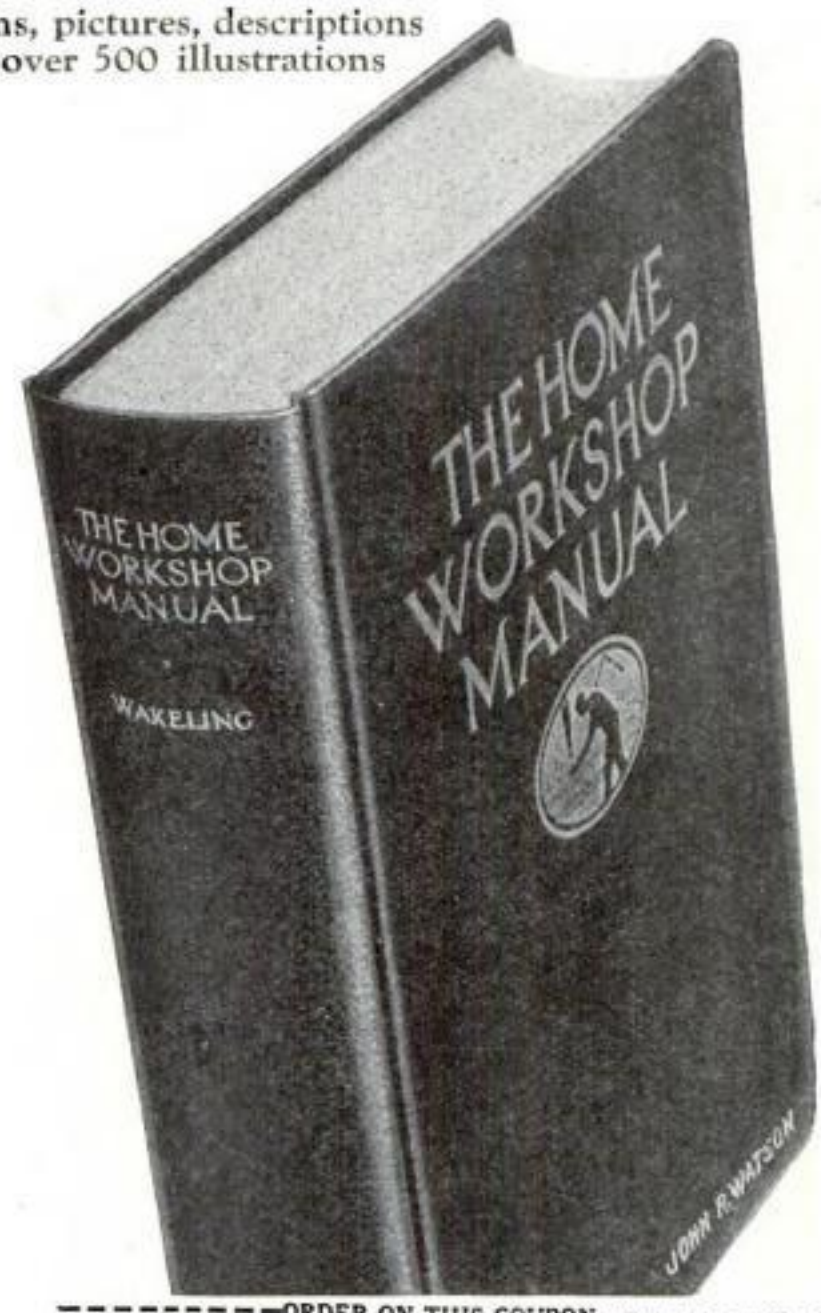

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Our Readers Say

Perk Up, Daydreamers, for the World Is All Yours

AT THE hide shop, someone bored a hole in the wall just outside the door, and stuck a calf's tail in it. The old Professor came along, and stopped to study out how they had got the calf through the hole. Dr. Poffenberger states that only children, and grown people with an inferiority complex, daydream and draw on their imagination. All play writers, actors, story writers of fiction, must be troubled that way. I think the person that has to work at common work, and has the ability to lift himself out of it by daydreaming, has a superiority complex. Without cost, regardless of time or place, he can soar to any height he wishes. He can command the whole show, and arrange his actors to suit himself, and without a cent of cost, too. As for riding past the station, he is no more liable to do so than is Dr. Poffenberger or the Professor trying to figure out how they got the calf through the hole in the wall. —R.D.N., Bonita, Calif.

Rocket-Driven Plane in Space Could Go Some!

H.C.K. BRINGS up several questions regarding interplanetary travel. First a propeller works because it gives a backward motion to the air. Newton's law of motion states: Action and reaction are equal and opposite. The force applied to the air and to the plane are equal and in opposite directions. In empty space there would be no reaction with a propeller. In the case of the rocket, the motive force is applied in driving the gases out of the rocket. Again the force is applied equally and in opposite directions to the rocket and to the gases. While the plane is useless in space, the rocket is at its best because there is no friction to retard the motion. Anyone can easily prove this if he measures the recoil of a revolver shot in air and in vacuum. In order to reach the moon with the least expenditure of energy it would be necessary to travel at the highest *acceleration* that the human body could stand. The trip could be made in less than half a day, and a maximum velocity of several miles per second would be reached safely.—H.E.C., San Diego, Calif.

The Radio for Oscar, but a Phonograph for Him

THREE cheers for Oscar, the wax dummy with a microphone ear who listens to orchestra rehearsals at Philadelphia, as told in a recent issue of POPULAR SCIENCE MONTHLY. We need more Oscars. They could sit and listen with their unsensitive ears to the evening radio program, while we get out the old family phonograph and dust off the records, devoid, happily, of all advertising drivel.—E.R.G., Joplin, Mo.

This Tiny Criticism May Seem Like a Boost

I HAVE been a reader of your magazine for about fifteen years, and am positive it is substantially better than the smaller edition of the prewar days. Your articles are good and my only suggestion would be to make them just a trifle more technical—they are almost too "popular" at present. Your Home Workshop section is excellent, and to me the most interesting part of POPULAR SCIENCE MONTHLY. The blueprint service is comprehensive and a godsend. Have built six ship models from your articles and blueprints, and like the articles on furniture building. The whaling ship by Captain McCann will be well received by your readers.—R.R.Y., Cincinnati, Ohio.

Anyway the Training Won't Hurt the Adventurers, Will It?

I HAD to smile when reading in a recent issue that exploring has been included in the curriculum of Harvard University, and that a diploma from the new Institute of Geographical Research at Cambridge qualifies a young man to head an expedition. Though I am not an explorer, I have read enough about exploration and talked with enough men who have gone into strange lands to know that the business is not so simple as all that. You might as well say that being graduated from West Point enables a brand-new second lieutenant to lead an army in the field in war-time, or that an Annapolis diploma qualifies a youngster to take charge of a fleet. If ever there was a game in which a rigid apprenticeship and long experience are required to fit a man for leadership, that game is exploring.—B.A.McM., Evanston, Ill.

Square Roots, This and That Clear Up Apple Problem

THE apple problem submitted by P.H., New York, is less complicated than he would have us believe and one that any high school boy could readily solve. In the first place the term dozen means a quantity twelve; the term gross, a quantity one hundred and forty-four; (and we will add, the term hundred means a quantity one hundred). So, when he says twelve dozen he means 12 times 12; when he says one gross he means 1 times 144; (and we will add that sixteen hundred means 16 times 100.) Now, the square root of the product of any number of terms is the product of the square roots of the terms. In the case at issue the square root of twelve dozen is not "about three and a half dozen or forty-two," but is the square root of twelve multiplied by the square root of a dozen—the square root of 12 x square root of 12. This obviously is 12. The square root of one gross is not "one gross or 144," but is the square root of one multiplied by the square root of a gross—the square root of 1 x square root of 144. This is 1 x 12, which equals 12 again. And, let us add, the square root of sixteen hundred is not four hundred, but is 4 x 10 = 40.—E.S.F., Tallahassee, Fla.

Here's a Plea for Thirty Nights of Reading in Each Magazine

IF I could put in writing what I think about your magazine you would need to make it some larger. At that, I don't see why you can't make it about three times bigger than it is now, so I could put in about thirty nights each month reading it. I get more good out of your magazine than out of all the other magazines and papers put together. Each month I have a race with my son, the instant the magazine comes into the house, to see which one will get it first.—G.B.F., Russell Point, Ohio.

Another Plan to End the Depression Bites the Dust

I HAVE just read the letter of O.D.E. in "Our Readers Say." I don't agree with a single point. He says, "Let the Government of the U. S. pay every male of fifty years and over a monthly pension of $80." Neither I nor any other self-respecting American wants charity. Second point: "Let it set a maximum price on farm products." Why bother with anything as useless as that? The people don't pay a price now that is sufficient to assure the farmer a decent living. Third point: "Establish a high tariff." A high tariff will help the manufacturers, but not the working man. Fourth point: "Develop a public sentiment that insists the entire pension be spent each month." Try and do it. Fifth point: "Put a five percent wage tax on male citizens." That is taxing the working people who are already taxed too much.—R.V.DE.P., Monsey, N. Y.

Anyway, Einstein Has One Stalwart Defender

I WISH to defend the Einstein theory from the attacks of E.H.P., Wellington, Ohio. The red shift is due to the gravitational influence of a large mass on the light ray giving it a lower frequency. I should like to know what he means by "cosmic expansion" and also where he gets the fifth dimension from Einstein? Einstein uses only four and he didn't invent the fourth. However, E.H.P. uses the disproved Newtonian hypothesis to invalidate Einstein, though Newton was disproved long before Einstein offered his theory. His phrase, "assuming that gravity is the effect of the pressure of the ether" is a

hard pill to swallow. Sir Oliver Lodge has proven beyond doubt that ether passes through all bodies and that these bodies exert no influence upon it—if it exists. Furthermore, Einstein has nothing whatever to say or do about the ether.—R.G., Bryan, Ohio.

Science Butts Its Head Against Ghosts and the Occult

IT SEEMS to me that science is butting its head into many things these days. When it begins to attack an institution as old as the world itself—namely astrology—it is time something was done about it by the people. You may call me an old numbskull fogy, but there are some wonders in the realm of the occult that science has yet to explain. There are, if you ask me, those who are gifted with supernatural powers that cannot be explained away by fretting scientists. I must say I was very interested in the articles on evolution. They were such amazing fairy tales that I could not wait for the next issue to see what new concoction Dr. Gregory had prepared.—J.P.R., Detroit, Mich.

Visiting Fireman's Car a Familiar Sight to Him

I AM an ardent reader of your magazine. I enjoy especially your articles on aviation. I hope there will be many more of them. Your article on a college on wheels for firemen was interesting to me in more than one way because Chief Murray's car was a familiar sight around New Haven a few months ago. I haven't happened to see it lately. Keep up the good work and don't listen to all those people who want this or that in or out. I think you are satisfying the greatest number of people in the way you are now varying articles. Some people can never be satisfied, so I guess you have your troubles.—C.W.P., West Haven, Conn.

These New Sun Lamps Have Got Him Worried

I THINK many of your readers, like myself, find themselves in the position of wanting to use the new sun lamps but unable to afford to scrap costly fixtures to install others which are said to be required. How do these "special" fixtures differ from those now in use? Surely they can't be different electrically. And if the harmful rays are eliminated by the bulb itself why can't these lamps be used in standard reflectors? If they require an odd-size receptacle cannot an adaptor be used as in the radio tube field? I think an article on this subject would go over well.—W.V.H., Brooklyn, N. Y.

But How Will You Get the Tape Line Around the World?

HERE is a problem some of your readers may be glad to solve for me, and so give my troubled spirit rest: The earth is approximately 25,000 miles in circumference. If you stretch a steel tape around the earth at the equator as tightly as you can possibly stretch it, then cut it and insert ten extra feet, then equalize this all the way around, how much would there be between the tape and the surface of the earth?—N.M.M., Liberal, Mo.

Science Is Wonderful but Taxes His Faith

THIS is the age of reason, and far be it from me to make it otherwise. I do not believe in accepting everything that comes down to us just because our great-great-grandfather said it should be that way. Nor on the other hand do I believe in discarding everything grandfather said just because he said it—at least not until something more believable is found as a substitute. I am wondering if the scientists who have very broadmindedly taken God out of our universe haven't become too broad for depth. Science has done wonderful things for this world, but if I am not mistaken, a certain form of it will yet be the rock on which our civilization wrecks itself. It takes more faith than I possess for me to think that some ambitious bit of inorganic matter created itself a few trillion years ago, then proceeded to expand and throw pieces off until it finally produced a universe, with a perpetual automatic power plant and every wheel in the proper place! An atheist cannot even explain a flower, not alone a universe.—M.G.V., Angwin, Calif.

Here Are a Lot of Things You Probably Never Knew Before

WHAT is gravitation? It is high frequency impulses traveling in all directions. Where does radiant energy go? Out into space where it is converted into shorter impulses, or gravitation. What is the earth? A small particle of matter in motion. Impulses of gravitation hit it from every direction. Why do we think that the earth attracts? Because it offers resistance to the passage of gravitation and the result is that things are pushed toward the earth. What causes the heat in the interior of the earth? The resistance to the force of gravitation. The more matter, the more resistance and the more heat. At what speed does gravitation travel? At the speed of light. That is, light rides along with the impulse of gravitation. —E.J., North Jackson, Ohio.

Your Moon, Old or New, Couldn't Change Spuds He Grew

"DO POTATOES Grow Bigger When Planted in Moonlight?" I say, no! It does not matter whether the moon is full, half-jagged, or down and out. We have been farmers for four generations back and we always planted when the ground and season were right, regardless of the moon. Potatoes, half planted in the dark of the moon, and half planted in the light, produced the same size and quality. But how about this: Early frosts in the fall or late frosts in the spring, if in the full of the moon, do little or no damage; this has been my experience. Why is this?—R.L.R., Worden, Ill.

Attention, "Kickers": Read and Then Watch Your Step

FOR a long time I have been wanting to write you a letter telling you that among your thousands of readers here is at least one that doesn't kick. I read your magazine regularly and think it is the best of its kind and the best on the market. If I find anything I don't like or am not interested in, I always think to myself that there are plenty of people who do like it. Some of your readers seem to think that the magazine is published for their special benefit and should be edited according to their likes and dislikes. If the kickers don't like the magazine, why do they read it? It is terribly hard to please the public and I think you are succeeding wonderfully at the job. Your magazine suits me perfectly—keep up the good work.—E.B., Dolgeville, N. Y.

You're Doubtless Right, Old Man but What, Where Is Machin Shan?

IN A recent issue of POPULAR SCIENCE MONTHLY I read your interesting article "Seven Highest Peaks Still Challenge Climbers," and noted in your list that Machin Shan, a mountain reputed to be higher than Everest, is among a few of the missing. Last November, an expedition left for Tibet to attempt to climb and determine the height of Machin Shan and to carry on research for the American Dental Association. The expedition, headed by Gene Lamb, explorer and lecturer, is making its headquarters at Lake Kokonor in northern Tibet. I feel that this letter should be brought to the attention of your readers because I think that an expedition that attempts such a difficult feat should receive full credit.—L.M.A.,Jr., New York, N. Y.

Put Red for Green and Stop Auto Accidents

HERE'S a way to stop these terrible automobile accidents. Psychologists have found that the effect of a red light is irritating. It makes an automobile driver want to step on the gas and plow straight ahead. A green light, on the other hand, is restful and soothing. It makes a driver want to sit still. One way to cut down the number of accidents at street corners would be to reverse the traffic light and have green for stop and red for go. Then they would be scientifically correct. Some of your flaw-picking subscribers may find fault with my idea, but if they don't like it, what plan have they to offer?—E.A.T., Glendale, N. J.

Objections All Noted, but Do You Other Readers Agree?

You have without doubt the best Home Workshop Department of any magazine of your field and your long articles are generally interesting and instructive. I realize that you can't satisfy everyone but the thing that gripes me is the quantity of short bits scattered among your front pages. You call yourself Popular Science but how you reconcile that title with some of these little articles is beyond me. If they were even of general interest I could forgive you. For heaven's sake, if you must print such articles do it in a separate magazine. Also if you cut out part of my letter and leave out the wrong parts I'm going to be madder still.—W.A.B.,Jr., New York, N. Y.

He Couldn't, by Chance, Be a Bit Sarcastic?

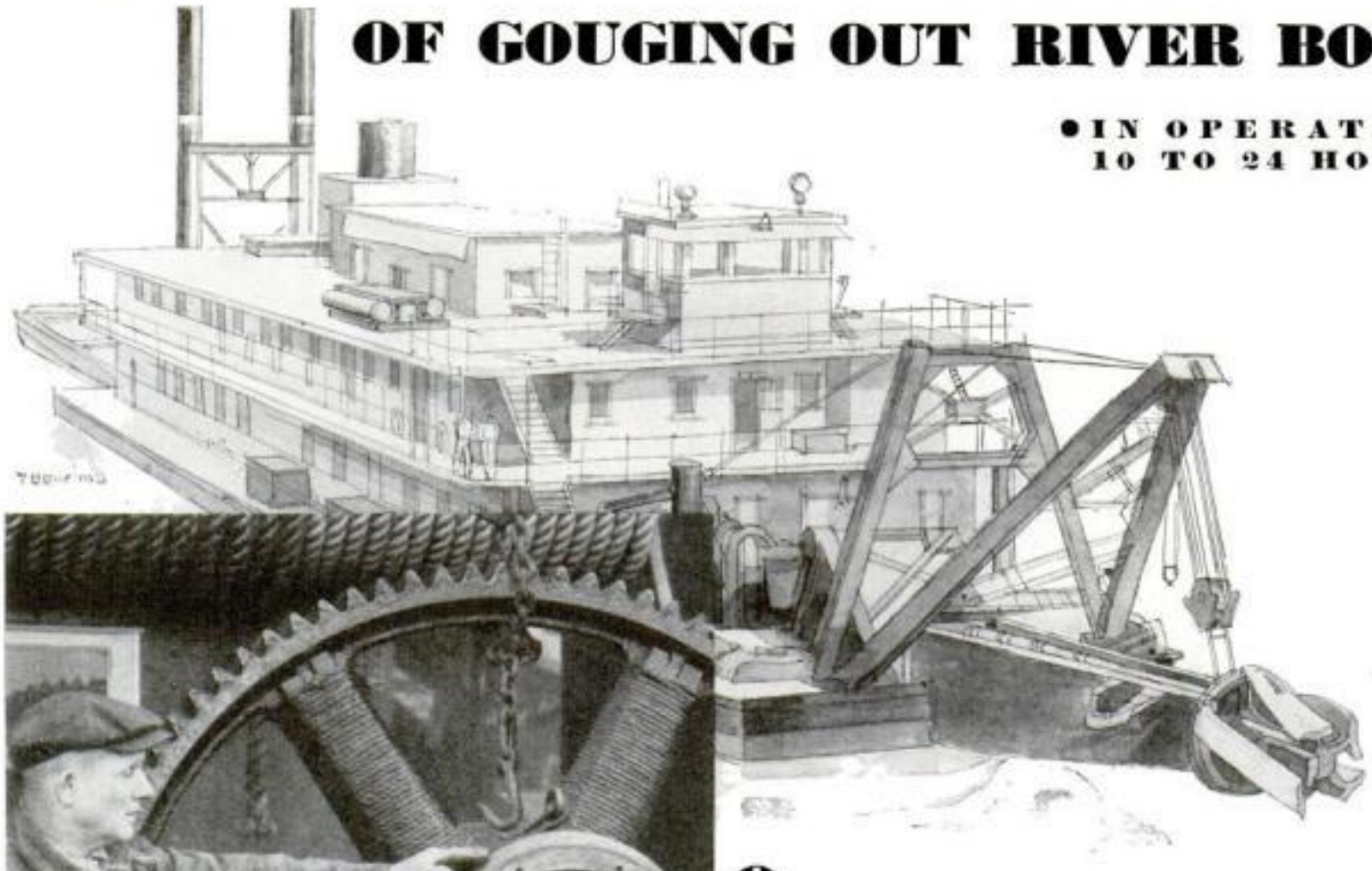
I AM constantly amazed at the genius POPULAR SCIENCE MONTHLY displays in digging up new ideas for its readers! As an instance, see the article about milk companies putting rubber pads on horses' feet to stop noise. Noise, hell! I used rubber pads on my horses thirty years ago to relieve them from the shock as their feet struck the stone roads.—B.S., Philadelphia, Pa.

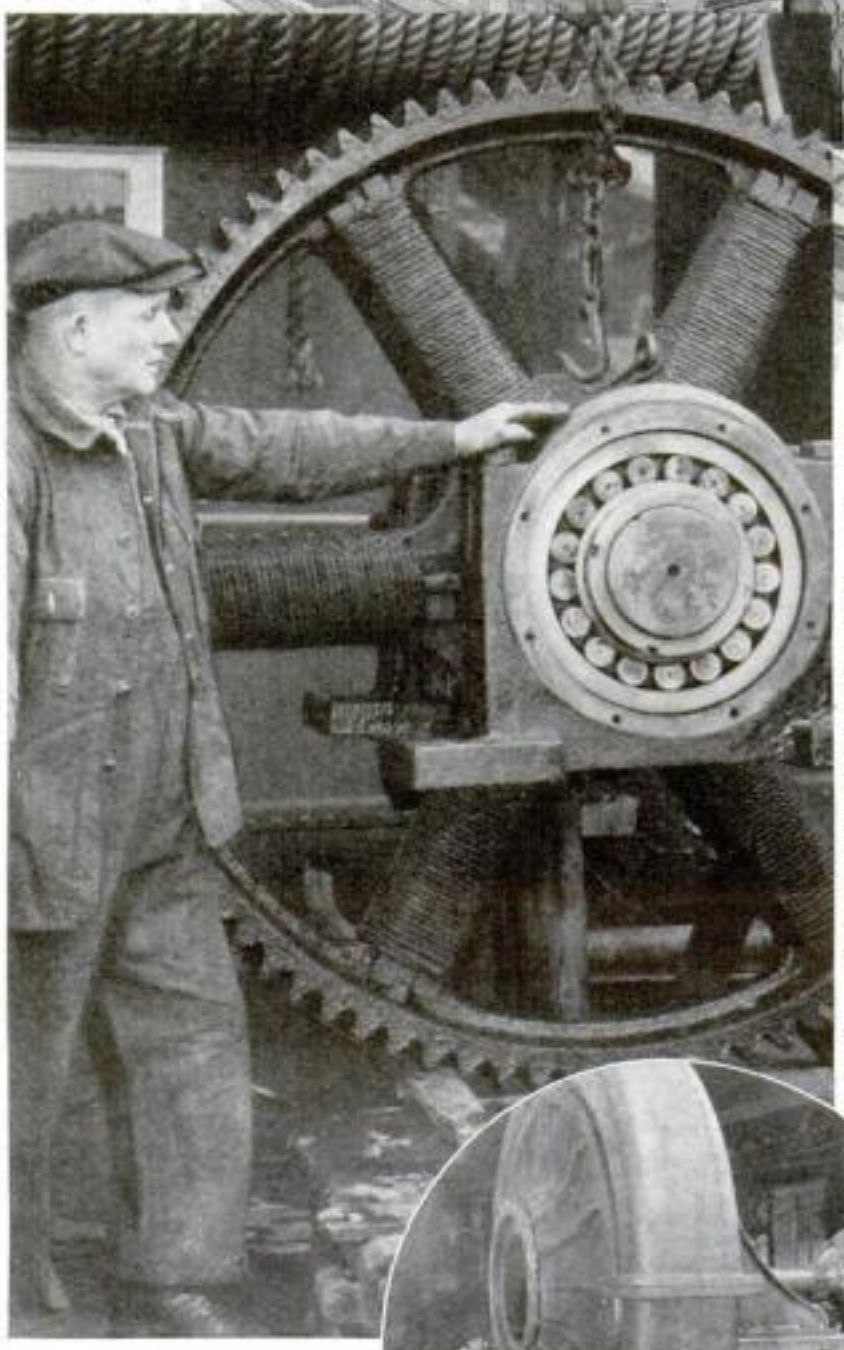
Close-up of cutter-head on government dredge "C. B. Harris"

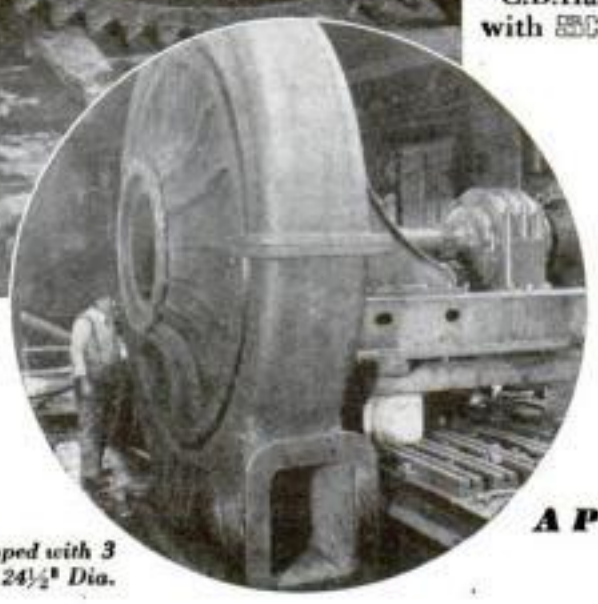
8 YEARS

OF GOUGING OUT RIVER BOTTOMS

• IN OPERATION FROM 10 TO 24 HOURS DAILY







SKF Bearing on intermediate gear of cutter head drive of "C. B. Harris"

Main Pump equipped with 3 SKF Bearings 24½" Dia.

ONE OF THE *TOUGHEST* BEARING JOBS IN THE WORLD

No place for bearings that lack backbone...a river dredge. Not when they are used on the giant gears and shafts of cutter heads that burrow into everything from ooze to solid rock. Not when they are used on the great pumps that pick up this mass of material and convey it. So the United States Government does the usual thing where a tough bearing job is encountered. It forgets price . . . and selects SKF.

The U. S. Government Dredge, "C.B.Harris," is equipped throughout with SKF Anti-Friction Bearings.

Cutter head drive, pump drive, pump impeller, electric motors... all operate on SKF. Just one of the 9 SKF Bearings weighing from 280 to 700 lbs. each is illustrated here . . . supporting the giant intermediate gear on the cutter head drive. All the bearings were installed 8 years ago, and have been in service from 10 to 24 hours a day almost every day. And they haven't yet begun to show wear.

When there's no room or time for failure, the bearings always are SKF.

SKF INDUSTRIES, Incorporated
40 East 34th Street, New York, N.Y.

SKF

BALL & ROLLER BEARINGS

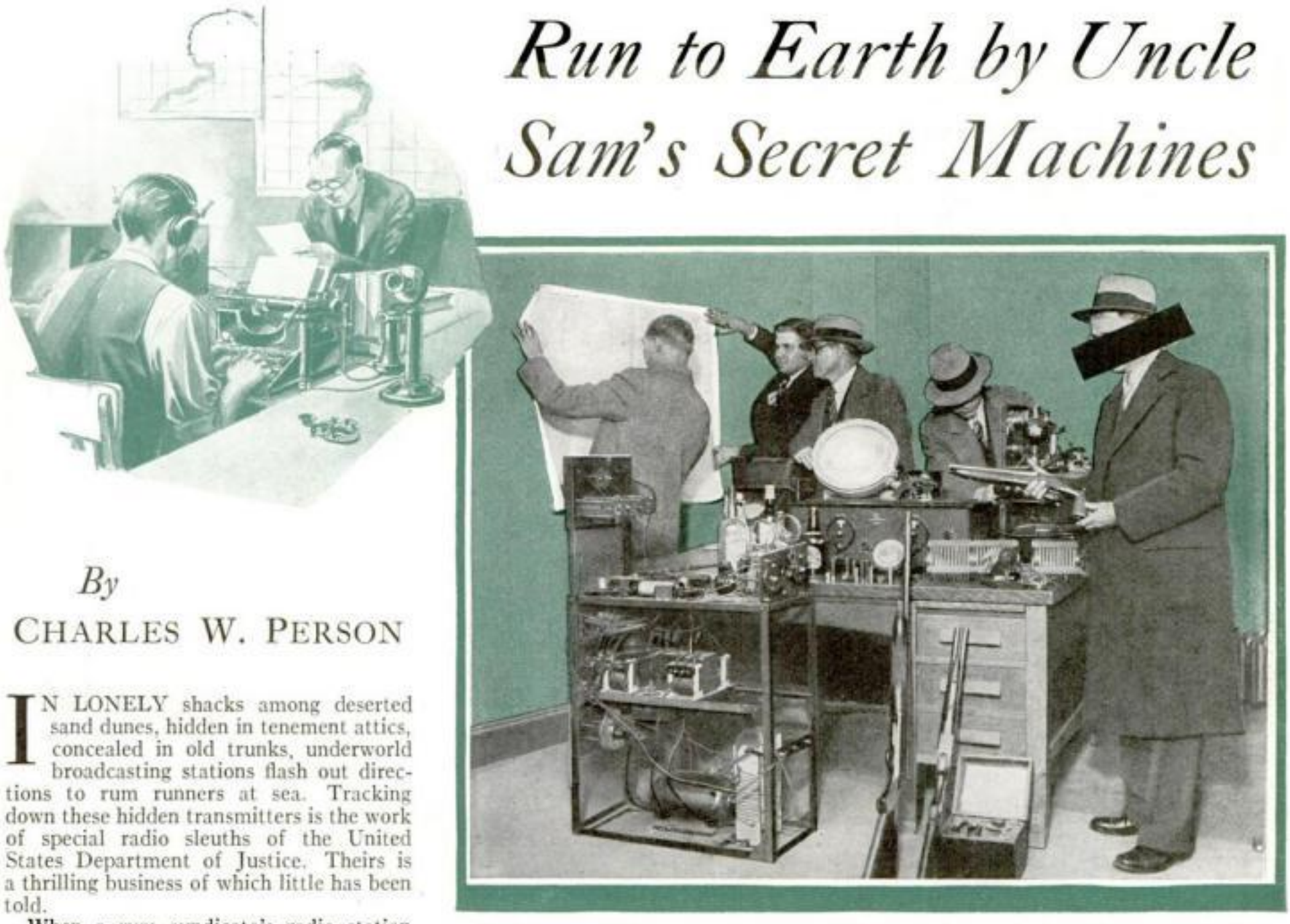
2859

A PROMISE IS ONLY A PROMISE ...PERFORMANCE IS HISTORY

POPULAR SCIENCE
MONTHLY
June 1932 Vol. 120, No. 6
RAYMOND J. BROWN, *Editor*

Outlaw Radio Stations

Run to Earth by Uncle Sam's Secret Machines



By
CHARLES W. PERSON

IN LONELY shacks among deserted sand dunes, hidden in tenement attics, concealed in old trunks, underworld broadcasting stations flash out directions to rum runners at sea. Tracking down these hidden transmitters is the work of special radio sleuths of the United States Department of Justice. Theirs is a thrilling business of which little has been told.

When a rum syndicate's radio station is silenced a hard blow is struck at that business. The ships loaded with liquor—and perhaps narcotics and aliens—riding the rough waters off shore instantly become deaf, dumb, and blind so far as shore intelligence is concerned. The high-powered ship-to-shore delivery fleet cannot function. To set up a new station, secure another operator, make up new codes, and get the system working again is a job requiring, at best, several weeks.

In tracking down these rum ring radios, crack Government cryptographers first decipher the intercepted code messages. Then, trained operatives in fast cars begin the hunt. Using maps, compasses, and sensitive instruments that indicate the direction and intensity of radio waves, they trace these invisible vibrations of the ether to their source. Recently, I was privileged to follow one of these exciting raids on a "marked station."

Bootleg radio stations are generally prepared to defend themselves, as the weapons in this picture of a raided outfit proves. Note that faces of Federal agents in this photo and the one at top of page 14 are blocked out to prevent their recognition by the crooks they trail

The drama begins in a squat old building, without any street number or other mark to distinguish it. At the top of a flight of creaking stairs, you enter a small, sparsely furnished room where two Federal agents are on duty. One sits at a short-wave receiving set headphones attached and hands poised over the keys of a typewriter. At an adjoining desk, the other man is poring over a disarray of maps, code books, and sheets of paper upon which are written mysterious messages in letters of the alphabet. He is the cryptographer, skilled in deciphering code messages. The room is one of the secret radio listening posts of the Department of Justice.

"Here they are, right on time!" announces the man at the receiving set as the dot and dash staccato of the International Morse Code buzzes into his headphones. The keys of the typewriter spring into action, reproducing the following

After this illegal radio station was captured, the Federal agents, faces blocked out, listened to messages from the sea while the rum runners' operator was held prisoner in adjoining room

conversation between 2XO, the land station of a liquor gang, and 2PG, one of its ships on Rum Row.

2XO—IS EVERYTHING OK?

2PG—PRETTY ROUGH. BAD SWELL ALL NIGHT.

2XO—COLD WITH HIGH WIND HERE.

2PG—COME OUT HERE IF YOU WANT TO SEE REAL WIND.

2XO—THANKS. THIS SUITS ME.

The typewriter stops. The man at the receiving set looks bored.

"They're shooting straight stuff—no code," he explains.

"Don't worry," replies his companion. "They'll work into code after they warm up a bit."

Several minutes pass. Suddenly the radio man becomes tense and resumes his typewriting.

"Here she comes—and how!" he exclaims.

The typewriter keys fall in monotonous rhythm, line after line of code appearing on the paper. This continues for several minutes. Finally the operator shouts, "They're off." He yanks the paper from the typewriter and throws it across the desk to his friend. Then he picks up a telephone receiver and speaks rapidly:

"2XO, land station, in communication with 2PG, ship station. On air from 1:30 P.M. to 1:43 P.M. We're breaking down the code now."

One look at the typewritten messages just intercepted reveals combinations of letters, three or four to a group. To the layman it is all a scrambled mess, meaningless to eye or ear.

An hour later the decoding is completed as reproduced on this page. The messages meanwhile have been delivered posthaste to another department of the Federal service, one devoted to ferreting out the exact location of radio stations operated in defiance of the law. For several days now, Uncle Sam's operatives have been eavesdropping on Land Station 2XO and Ship Station 2PG. The latter is probably thirty to fifty miles out at sea, beyond the jurisdiction of the Government. It is the land station that the Federal inspectors are after.

The action now shifts from the Federal listening post to the open country. The hunt for 2XO is on. Two men, one carrying a compass, maps, and a small suit case, enter an automobile and hurry out of the city. The plan of these two experts is to get on "location," so to speak, a few minutes before 2XO opens up for its regular afternoon schedule at 1:30 and then make ready to spot it. A point is selected—any spot will do in the first stages of the search. The car is stopped. The man steps out with his suit case, compass and maps.

When opened the suit case reveals a sensitive radio direction finder. It is not the common variety of direction finder, however, but one improved in so many important respects that it bears merely a general resemblance to the equipment commonly in use. Just what these improvements are is not disclosed and you are requested to keep at a distance when the finder is being operated. It is just one of those little secrets that the Government wants to keep to itself.

It takes but a moment to make the proper adjustments and set up the tiny loop antenna which is part of the equipment. Everything is now ready to spot 2XO. At precisely 1:30 P.M., as anticipated, 2XO comes on the air. The finder catches the signals instantly, but they are weak and tend to fade. The antenna is moved directly in the path of 2XO's wave and the signals come clear and strong through the headphones or through a loudspeaker that may be concealed in the pocket of the operator.

The next step is to take a bearing by compass through the loop of the antenna, straight as a crow's flight to 2XO. The map is then oriented into proper position, a line is drawn, and bearing No. 1 is taken on 2XO.

The car is started and speeded to another location. Again the direction finder is brought into action and bearing No. 2 is taken and drawn on the map. The point where these two lines intersect gives the inspector the vicinity—not the exact location—of 2XO. All of this preliminary spotting work, it should be remembered, must be completed within a space of thirteen minutes during which 2XO is on the air during the afternoon.

The map is now carefully studied, and the sleuths know the general location of 2XO—know it within an area of at least a half mile square. The next move is to get on "location" in that half-mile area wherein 2XO is situated. They must arrive there by eight o'clock that night to catch 2XO's regular evening schedule. Sometimes this means a trip of six hours of the fastest driving possible—for example, from a point in New Jersey, across the river from New York, to a point at the far end of Long Island, or to upper Connecticut. If luck is with them, how-

```
 WUAT   WIJK   WOO   WTIO   WRT   WRZT
Patrol  boat    is   with    us   now.

 WNTO   WLRL   WRWL   WTKH
State   your  highest  speed

 WSSA   WQCV   WYBD
 Ten    knots loaded

WCCO  WPRI  WOYT  WQS  WKJT  WVCP   WSYM
Can   you   make  get  away   if  ordered

WVPL  WBQV   WCZT  WMDR  WLKX  WIVZ   WJBE
Oil   low.  Better wait until  fog   covers

WSXK  WABX   WRPK   WGTY   WFRS   WVPT
All  right. Resume eight  oclock tonight

WABX   WGTY   WFRS
Right. Eight oclock
```

Rum runners' code message picked up by Federal agents and decoded by Government experts

In the attic of a garage, where a lot of old trunks were stored, this bootleg transmitter was found hidden in a trunk. Note bottle of fire extinguisher in case short circuit started blaze

ever, and the car holds up, they will make it.

Eight o'clock again finds them on "location." This time they are within a scant half mile of their prey and caution must be exercised. Smugglers have a way of patrolling the highways surrounding their radio outposts that makes snooping a hazardous sport for any intruders disturbing their privacy.

WORKING as much under cover as possible the inspectors set up the direction finder and make preparations for taking a close-up bearing on their station. Less than a minute after 2XO's signals ride the ether, the first bearing is taken and the map marked. They speed to another place and there take their second close-up bearing. The intersecting lines now reveal the location of 2XO within an area of at least a few hundred square feet—perhaps much less than that.

The car gets under way without delay and out comes the Government's pet device that can tell within a foot or, indeed, within a few inches, where the illegal station is. This instrument is known as a field intensity apparatus. The improved ones used by Department of Justice agents are of their own making, and again secrecy is maintained concerning their special features.

This much can be said, however. The apparatus registers signal strength. The nearer it is brought to the source of the signal, the louder is the reception. In the space of a few minutes, with their area of suspicion narrowed down to a few hundred square feet, the inspectors tour the neighborhood to determine the exact place and the exact spot in that place where 2XO is hiding out. They don't need to double back on their tracks and recheck results to be sure. When the field intensity apparatus says in terms of its piercing signal registration, "Here it is, boys!" the hunt is over and the quarry is located.

Another act of the drama is thus completed. The inspectors head for the listening post in town and report results. They may discover that 2XO is in a garage along a crowded highway, or in the second floor rear apartment of a six-story residential building in a congested neighborhood, or in a shack on a sand dune miles removed from the nearest town. No matter where it is, Uncle Sam's radio sleuths can locate it to the final inch with the aid of their direction finder and field intensity unit.

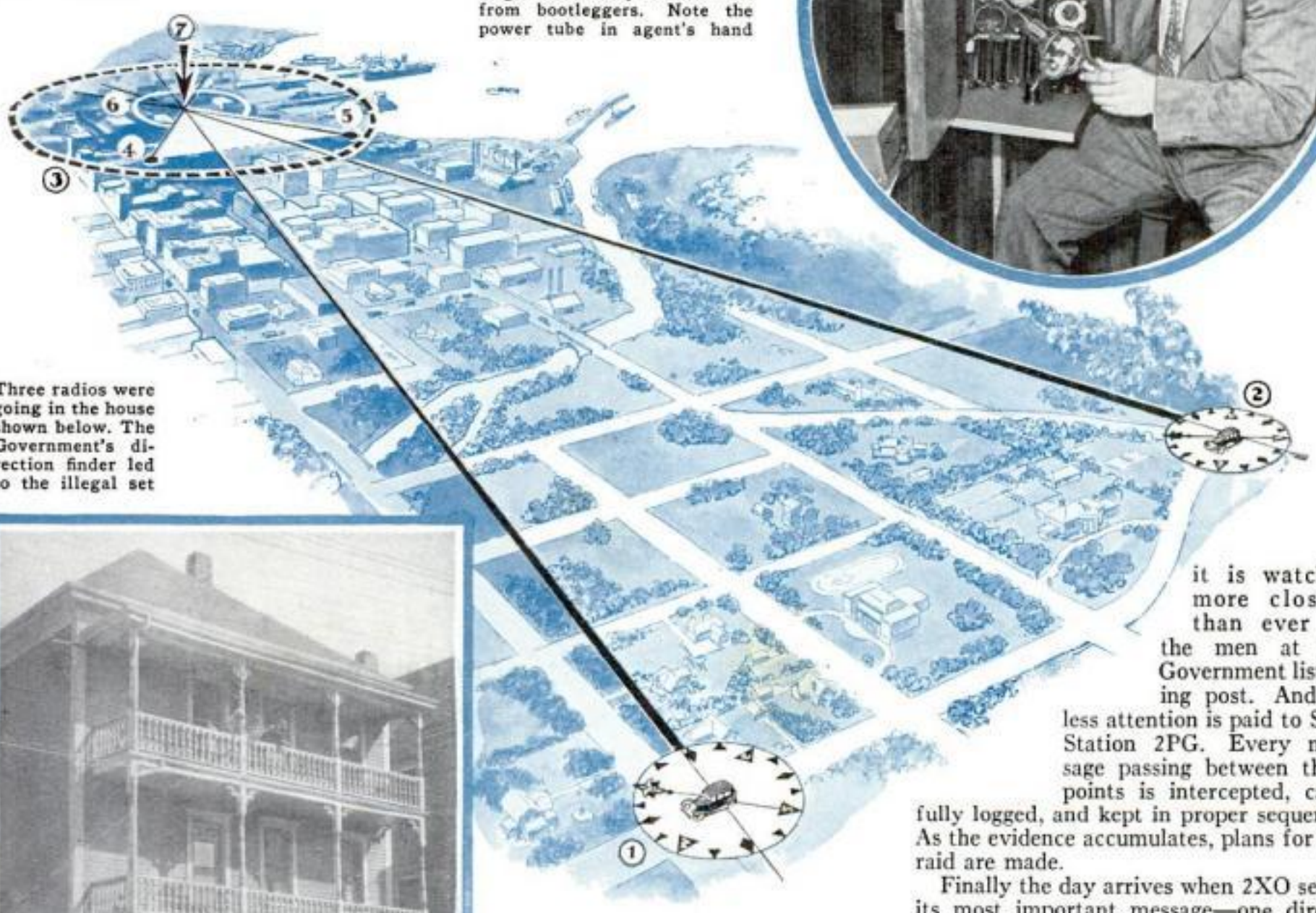
But suppose the operator of an illegal station is smart enough to switch to a different wave length when the Federal folks are on his trail? What then? It merely causes a slight delay in the hunting process, that's all. So expert are these radio sleuths that they can recognize the "fist" of an illegal operator by the characteristic way the dots and dashes are formed. They can tell to a nicety the exact power of a station, the make of tubes, and other facts that help tremendously in the smoking-out process. At most it is only a matter of a few minutes of further searching in the ether before the man and station have been located again and the hunt resumed.

When Station 2XO has been definitely spotted, or in the language of the Federal inspectors has become "a marked station," it is watched more closely than ever by the men at the Government listening post. And no less attention is paid to Ship Station 2PG. Every message passing between these points is intercepted, carefully logged, and kept in proper sequence. As the evidence accumulates, plans for the raid are made.

Finally the day arrives when 2XO sends its most important message—one directing its ship out on Rum Row to be prepared for orders to weigh anchor and proceed to an appointed rendezvous and there transfer its contraband cargo to high-speed cruisers eager to make the dash to shore.

There is no time to be lost now. The Federal agents get their search warrant and make ready to pounce upon 2XO, confiscate all radio equipment found on the premises as *(Continued on page 120)*

At right, compact transmitting set taken by Government from bootleggers. Note the power tube in agent's hand



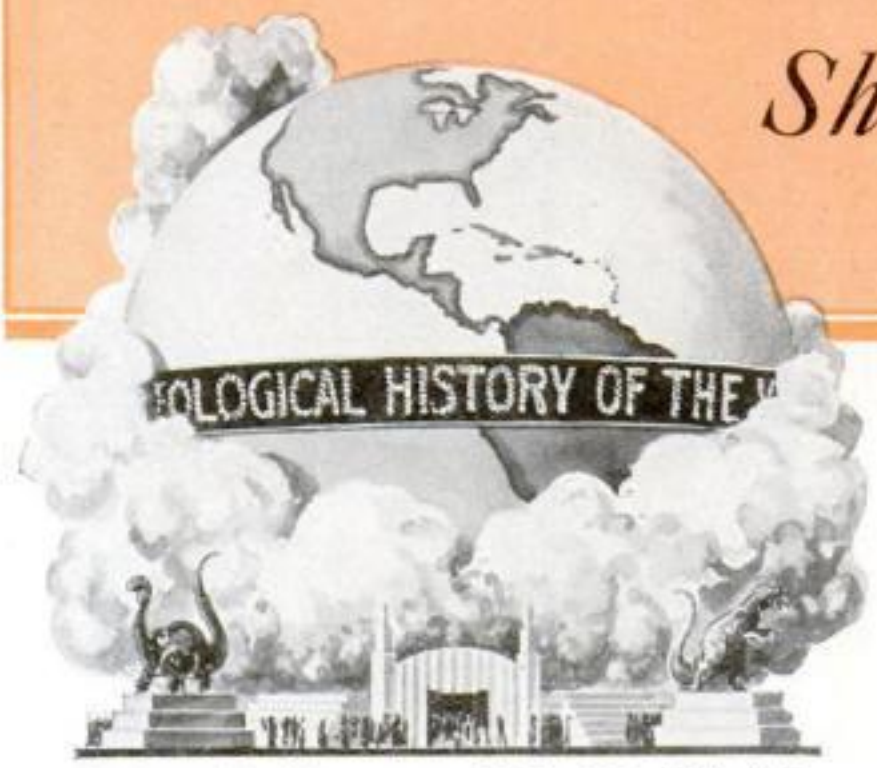
HOW THE GOVERNMENT CLOSES IN ON BOOTLEG RADIO PLANTS

Diagram above gives a clear idea of how illegal radio stations are found by the Federal sleuths. Nos. 1 and 2 are the points at which signals are first received. By means of these bearings the station is located somewhere within the large dotted circle, 3. At 4 and 5 new records are made and the area within circle 6 is found. The secret direction finder leads agents to station at No. 7

Three radios were going in the house shown below. The Government's direction finder led to the illegal set

Giant Metal "EARTH"

Shows Life Forms of All Ages



On the outside of the great metal ball, within which will be shown all forms of life, will appear a complete world map

By EDWIN W. TEALE

A MAMMOTH metal globe, as high as an eight-story building, will represent the earth and house one of the most spectacular exhibits at the Chicago World's Fair, in the summer of 1933. Within it, mechanical monsters in a strange prehistoric zoo will reproduce scenes that took place millions of years before man appeared on earth.

The exterior of the ball will be covered with a map of the world. The oceans will appear in gleaming, silver-colored stainless steel and the continents in metal painted turquoise blue. The land areas are to be set out slightly from the globe and varicolored lights beneath will be turned on for night display. An electric sign, moving on a chain, will encircle the equator, announcing the attraction within.

At five-minute intervals, from vents around the base, puffs of live steam will be released to float upward like clouds. At night, colored lights will play upon the billowing white vapor. When viewed from the ground, this will give the impression that the huge globe is floating among the clouds.

Inside, four elevators will carry spectators to the main floor, fifty feet above the ground. Here, they will follow winding walks that lead past swamps of prehistoric vegetation and cliffs that form the natural setting for the giant animals. They will see woolly mammoths, saber-toothed tigers, extinct giant turtles, dinosaurs fifty feet long, and carnivorous monsters two stories high, all breathing, eating, and fighting as though they were alive.

CONSTRUCTED of wood, steel, canvas and papier-mâché, they will be operated electrically. Each will contain from one to sixteen motors, ranging in strength from one-eighth horsepower to two horsepower. In all, approximately 500 electric motors will be used to impart lifelike motions to the animals.

Expert operators at switchboards will make these huge creatures swing their heads from side to side, roll their eyes, lash their tails, and open and close their jaws. Hidden where they can see the crowds, these operators will frequently give spectators an added thrill by having the monsters swing suddenly toward them with wide-gaping jaws.

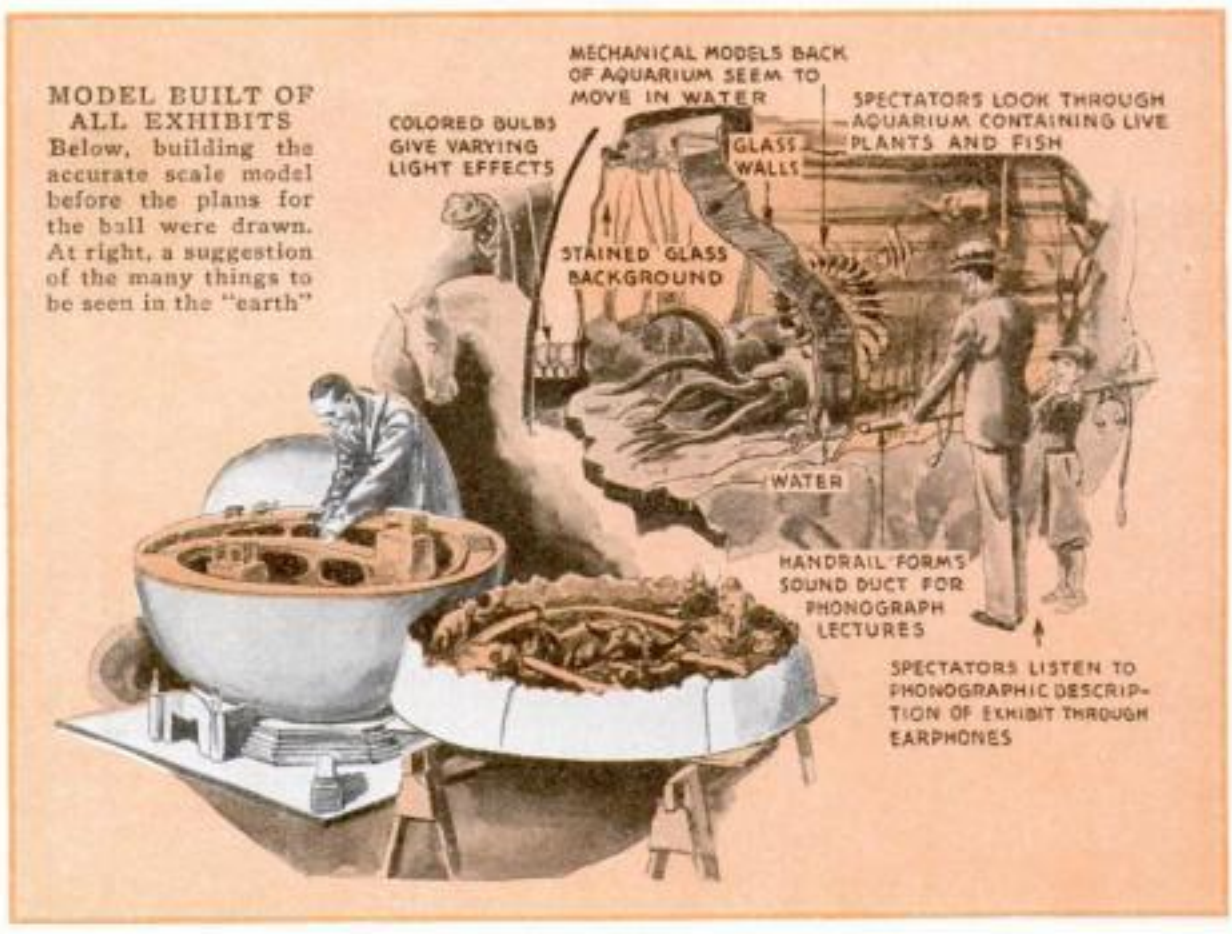
Along the railings of the walks there will be hundreds of earphones. By means of them, spectators can hear lectures on the characteristics and habits of the particular animal before which they are standing. These lectures will be repeated continuously by the use of phonograph records in a central control room below. Earphones will be employed instead of loudspeakers so there will be no interference with the sound effects which will add realism to the exhibition. The huge mechanical animals will not only move, they will also "talk." Onlookers will hear the snarl of the saber-toothed tiger, the hiss of the great brontosaurus, and the trumpeting of the prehistoric shovel-jawed elephant.

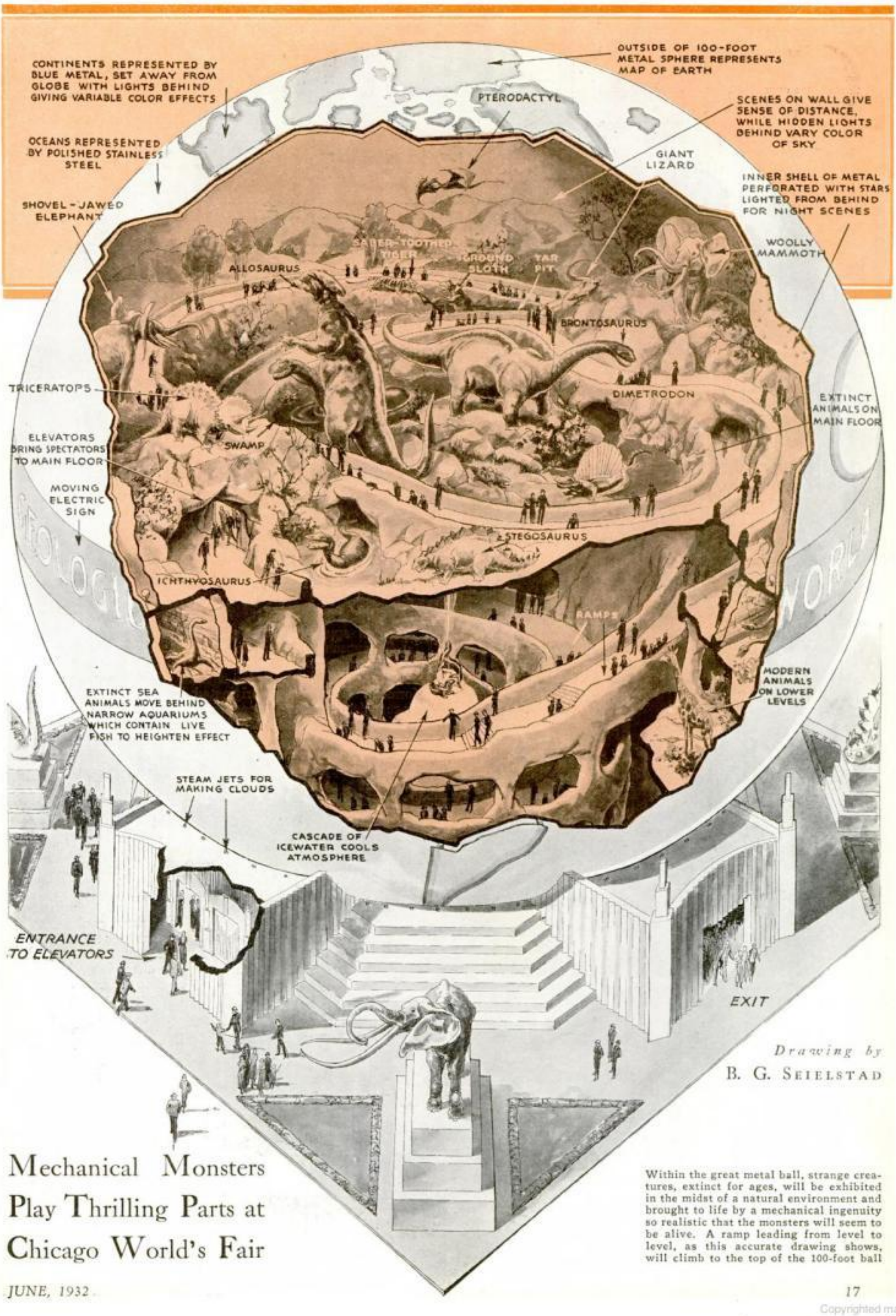
IN PREPARATION for this spectacular display, engineers of the firm of Messmore and Damon, New York makers of animated exhibition models, have been working for more than four years. Each animal is to be constructed the exact size of the beast it represents.

Realizing the educational value of the display, curators of the American Museum of Natural History, in New York City, have been coöperating to make the exhibits and their surroundings scientifically accurate.

One of the features of the main floor will be a reproduction of a "Death-Trap of the Ages," a tar pit similar to the La Brea Pit, in California, where the bones of many extinct animals were found. It will show a giant ground sloth mired in the tar, struggling frantically to get free, while a tiger crouches on the bank ready to spring.

At the center of the hall, a meat-eating allosaurus, towering twenty-five feet high, with a great bone helmet protecting its skull, will be attacking a fifty-foot brontosaurus wallowing *(Continued on page 119)*





Drawing by
B. G. SEIELSTAD

Mechanical Monsters Play Thrilling Parts at Chicago World's Fair

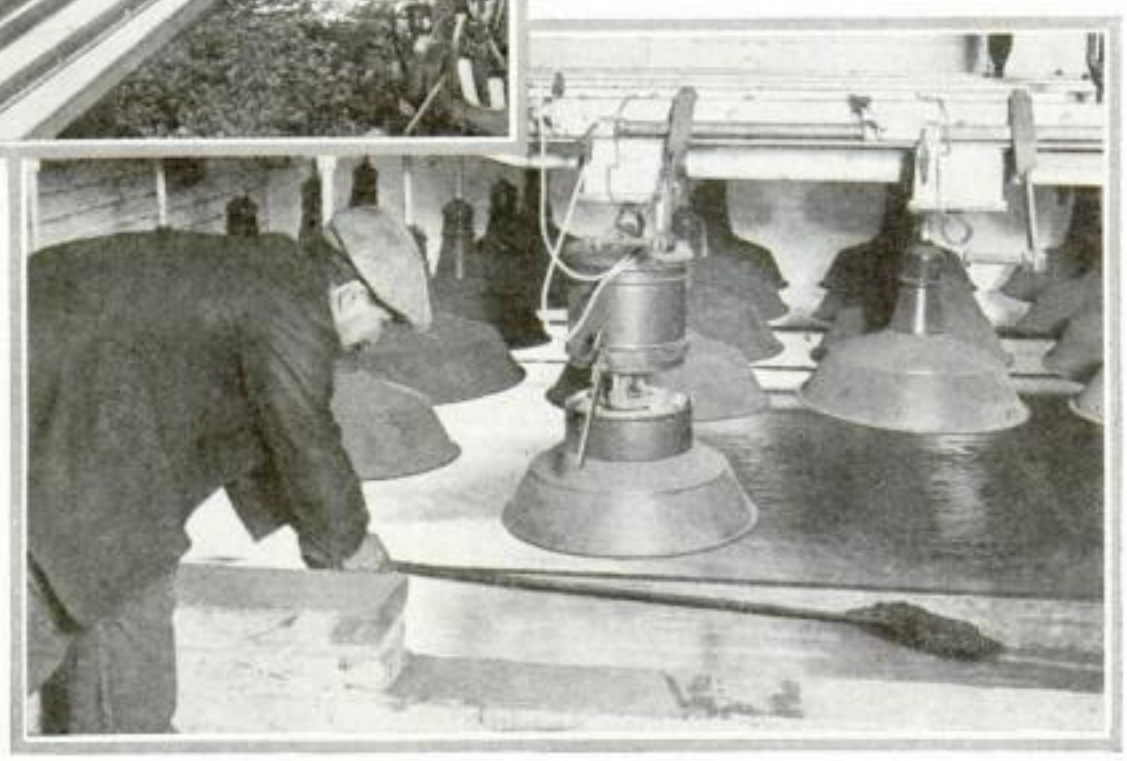
Within the great metal ball, strange creatures, extinct for ages, will be exhibited in the midst of a natural environment and brought to life by a mechanical ingenuity so realistic that the monsters will seem to be alive. A ramp leading from level to level, as this accurate drawing shows, will climb to the top of the 100-foot ball

Plant Wizards *with* MAGIC LIGHT *Grow* GREEN Apples RED

With the apparatus below, light is passed through the quartz prism and broken into a rainbow band before it hits the plant. In this way rays that are injurious to vegetables are detected

Experiments now being made at Boyce Thompson Institute are expected to revolutionize work in orchard and garden

On the track above, the plant is moved by an electric motor so that it is constantly in the spot of sunlight shining through the lens in the roof of greenhouse



No sunlight penetrates the concrete vault at right, but the plants are grown in a flood of powerful electric light that reaches them through a glass plate kept constantly flooded with water in order to absorb the radiant heat

GREEN apples are now grown a bright red at the Boyce Thompson Institute for Plant Research, Yonkers, N. Y. This amazing feat is accomplished by means of the ultra-violet lamp, in the rays of which the green apple is transformed. The process, originated by Dr. John M. Arthur, has far-reaching commercial possibilities and is expected to prove of enormous value to American fruit growers.

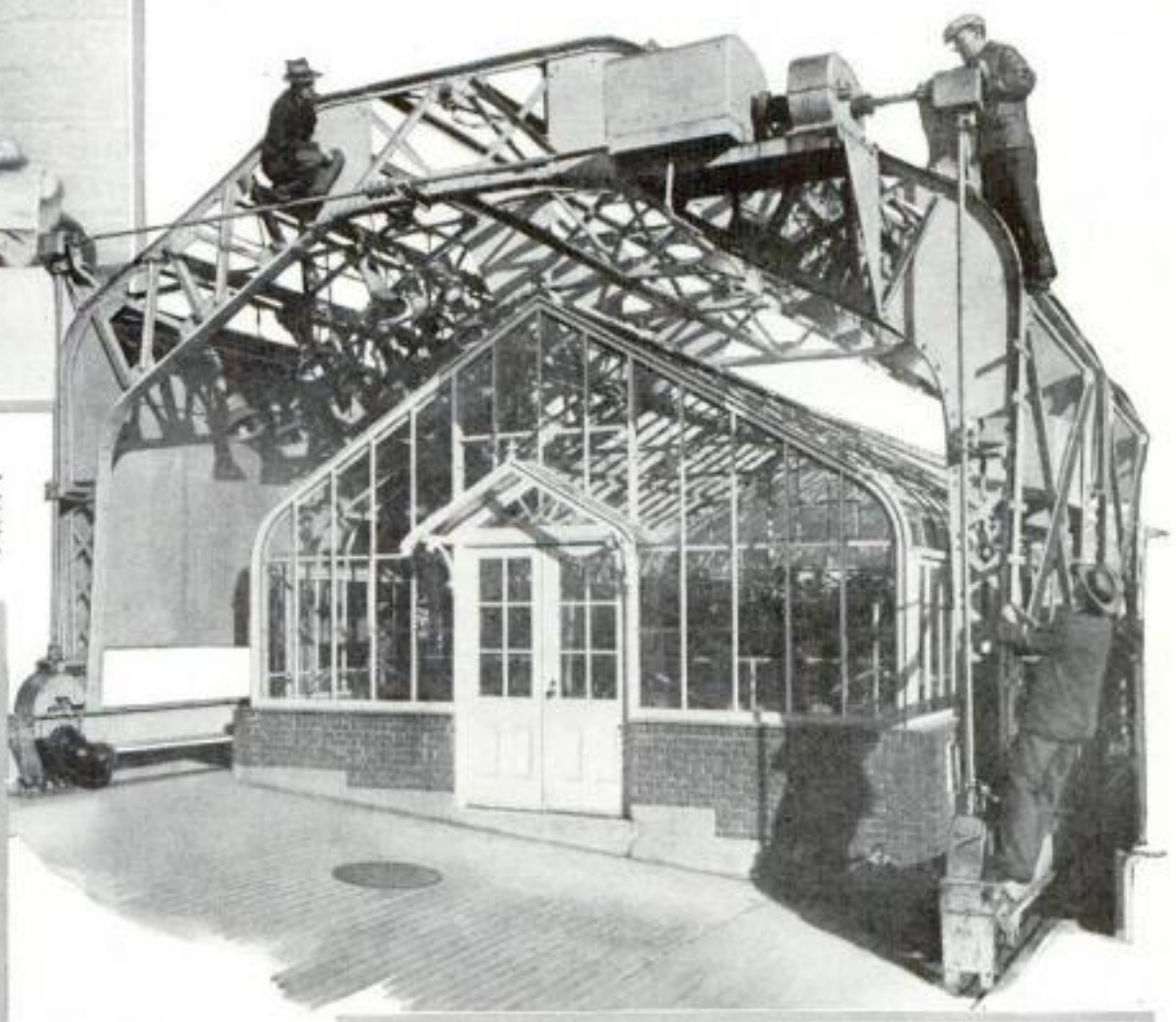
Apple consumers like their fruit red, and the blushing, scarlet streaked varieties always command the highest prices on the market. Many apples ripen to a white juiciness inside but retain the green skin that makes small appeal to the eye. Hereafter the miracle working method of Dr. Arthur may be extended to the entire yield of an orchard and the apples, green by Nature, will be ripened to a fascinating crimson as the magic light plays upon them. Indeed the plant wizards, beating Nature at her own game, can give the green apple an even, brilliant red all around while the apple, colored by the sun, will be darkly stained on one side and fade to an unattractive light pink or pale green on the other.

With only the sun to color them, apples need all the summer months to acquire their red, but with his ultra-violet lamp Dr. Arthur can give the greenest apple a rosy hue in forty-eight hours and in no way impair or change its natural flavor. The only apparatus required is the lamp, a pane of glass that transmits ultra-violet rays, and a refrigerator chamber in which to keep the apples cool during the process. Simple as it seems, it was only through patient experiment with a myriad of light sources and color filters that Dr. Arthur found the particular rays responsible for the mysterious transformation of

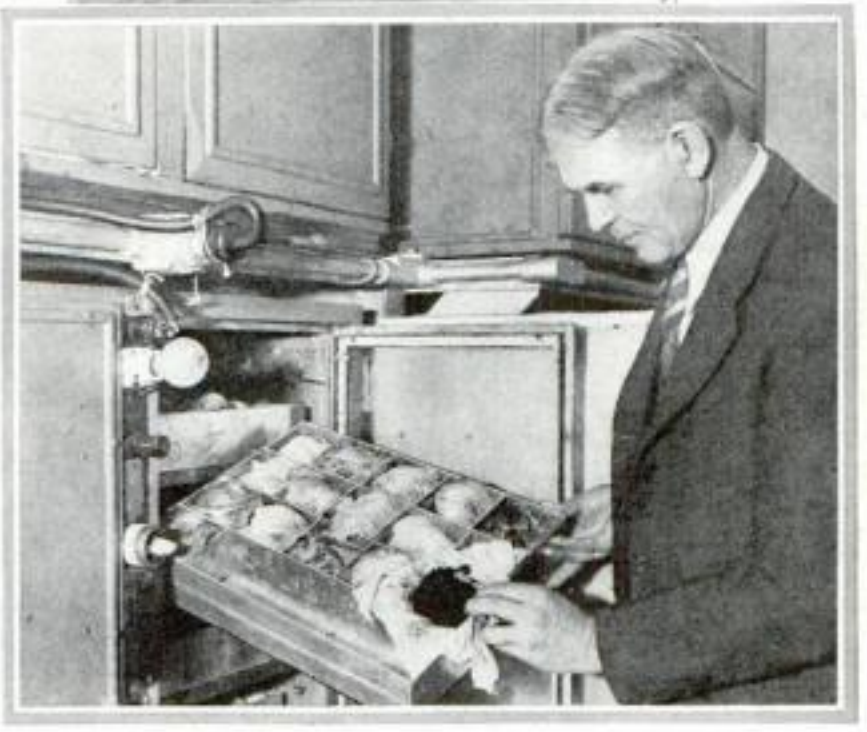
Dr. John M. Arthur demonstrates with mercury-vapor lamp and filter glass his process of turning naturally green apples red. Ultra-violet rays do it in 48 hours; it takes Nature months to do the job

NIGHT TURNED TO DAY TO AID PLANT GROWTH

The fifteen-ton structure below is rolled on railroad tracks over a greenhouse and at night its powerful lamps flood the interior with light, thus making the plants grow through a twenty-four-hour day



The plants at left are being grown upside down to learn how it is that illuminating gas poisons them. When kept in this inverted position it was found the gas did not injure them, thus showing gravity has a lot to do with it



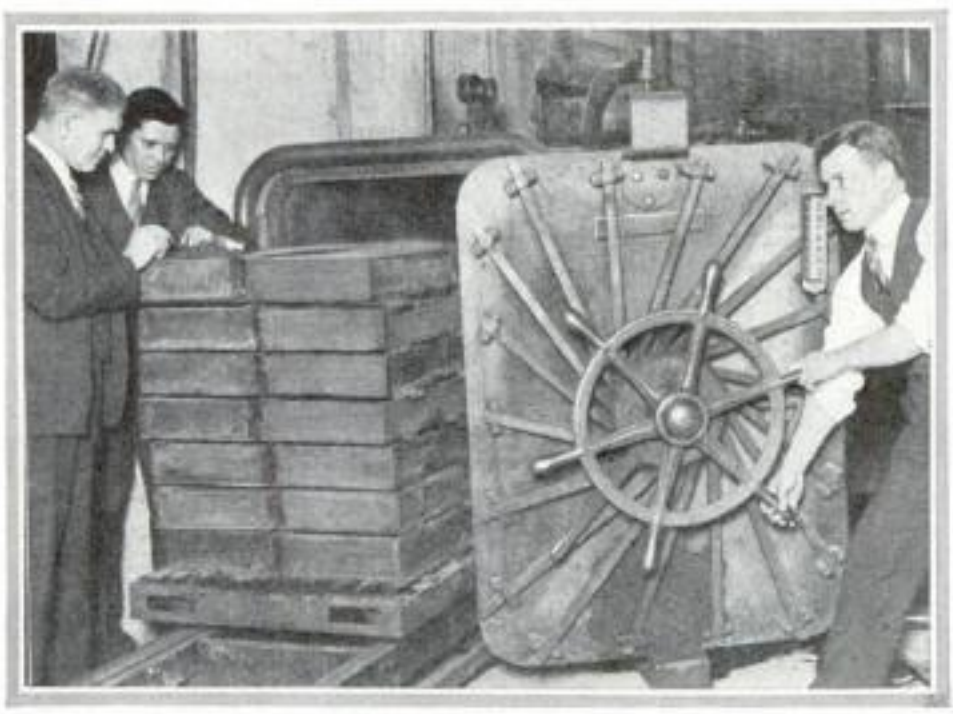
Seeds are placed in the refrigerator, right, by Dr. William Crocker, who has discovered that when they are chilled for a specified time they germinate better

the fruit, and learned how to use them.

Since the Boyce Thompson Institute is an endowed, non-profit-making organization, the new process of coloring apples will be presented as a gift to the world, as have been its many achievements in the past. Meanwhile its experimenters press on with other important and novel investigations.

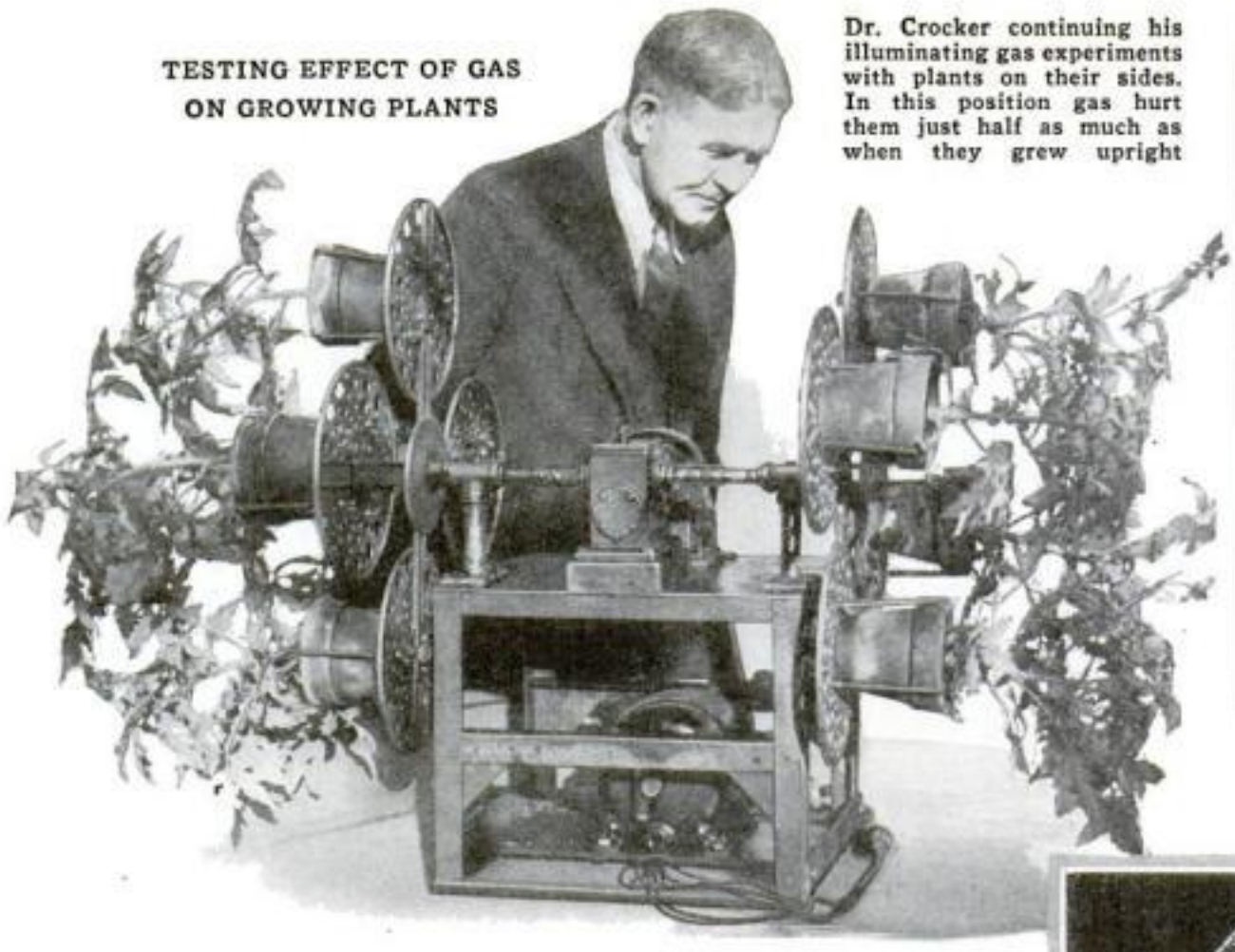
Plants are grown upside down. Flower pots travel along a railway, following a spot of sunlight from a huge lens in a greenhouse roof. An instrument resembling a spectroscope is used to imprint a rainbow pattern upon a leaf. Into a roomful of vegetation coal gas is piped, and the plants thrive on it. A rosebush droops and withers under a bell jar filled with illuminating gas. Fantastic as they seem, all these experiments have a well-planned purpose.

Leakage of illuminating gas from pipes in greenhouses causes a staggering loss to nurserymen by poisoning their plants, Dr. William Crocker, director of the Institute, told Popular Science Monthly. "We have found a way to detect it," he says, "as effective as the canaries that miners

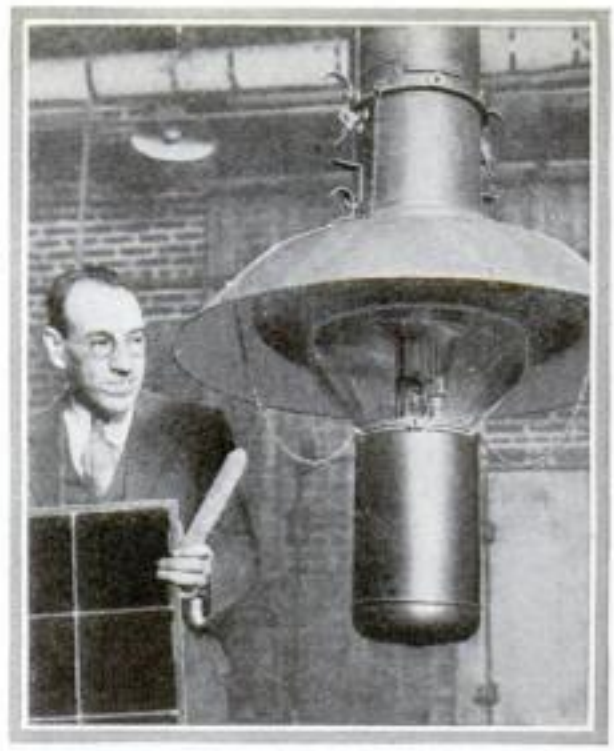


In the big tank, left, soil used at the Boyce Thompson Institute is given a steam bath for the purpose of killing all injurious organisms. Turning the wheel slides home bolts to lock the door

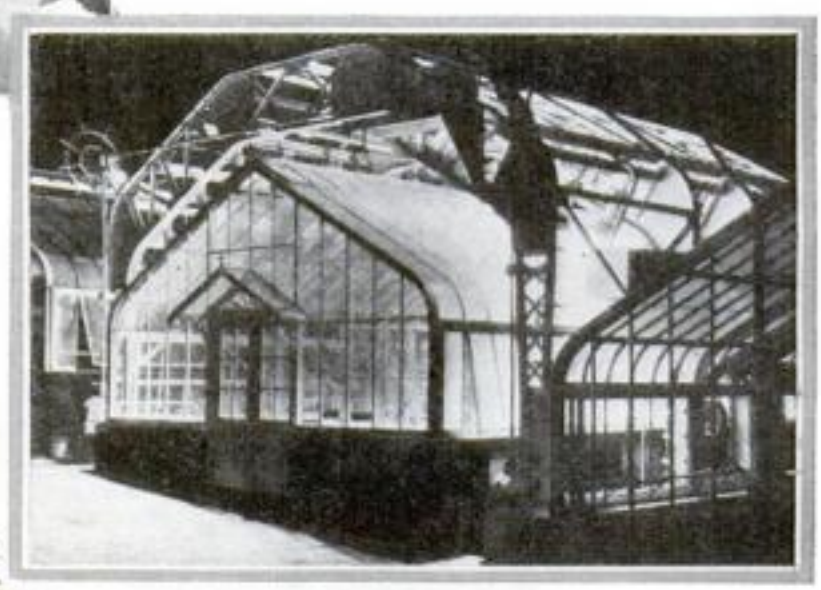
TESTING EFFECT OF GAS ON GROWING PLANTS



Dr. Crocker continuing his illuminating gas experiments with plants on their sides. In this position gas hurt them just half as much as when they grew upright



This giant arc lamp is used to replace sunlight. Note huge carbon stick that burns for 120 hours



carry down shafts to warn them of gas peril. The humble tomato plant is our lookout. So sensitive is this botanical 'canary bird' that it will detect one part of gas in 100,000 parts of air and warn of danger by its drooping leaves."

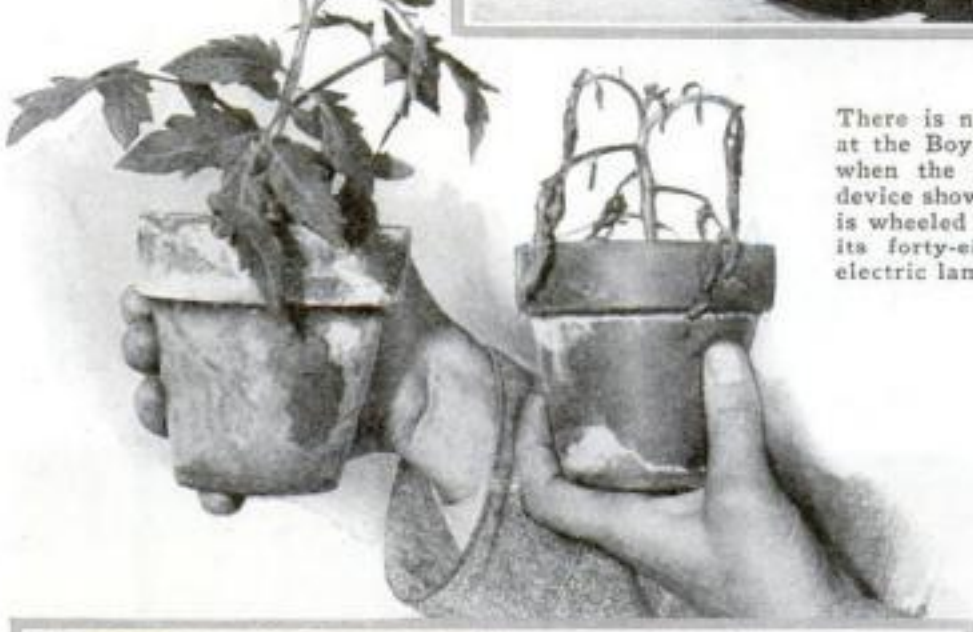
Not satisfied with learning how to guard against it, the Boyce Thompson experts want to know just how illuminating gas poisons plants. It was Dr. Crocker who conceived the unconventional notion of growing plants upside down while gassing them. His associates were first amused, then surprised. Inverted, the plants were immune to the poison! To complete his demonstration, Dr. Crocker placed a number of pots on their sides in a motor-driven machine that slowly rotated them, exposing all sides uniformly. Plants thus gassed showed exactly half as much damage as those that grew upright.

THE tests showed, Dr. Crocker says, what an important part gravity plays in the mechanism by which a plant absorbs the poison.

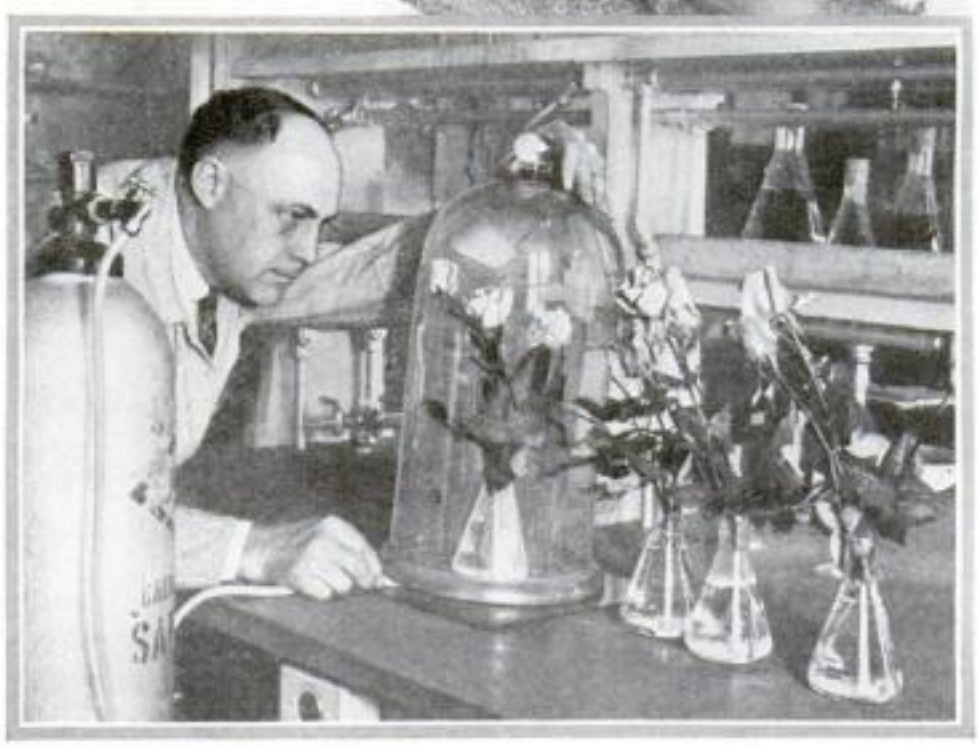
In another investigation to determine what rays of artificial light are "death rays" to plants, experimenters of the Boyce Thompson Institute are using a strange device that probably has no duplicate in the world. It resembles a spectroscope, and uses one of the largest crystal quartz prisms ever made—an $1,800 triangular block that took a year to manufacture—to split lamplight into a rainbow of colors. A fluorescent viewing screen makes this brilliant spectrum visible, and the leaf of a growing plant is clamped to the screen and exposed to the rainbow. In this way it is possible to "brand" a whole spectrum, even to its dark transverse lights, upon a growing leaf. Some of the ultra-violet rays just outside the range of normal sunlight will destroy plant tissue in fifty hours.

Dozens of such experiments, many of tremendous practical significance, are going on in this house of wonders, as shown in the accompanying photographs taken especially for POPULAR SCIENCE MONTHLY.

If there is the least bit of illuminating gas in the greenhouse, the tomato plant, below, will warn of its presence. Its leaves droop when they come in contact with the tiniest portion of the gas



There is no sleep for the plants at the Boyce Thompson Institute when the huge electric lighting device shown on the previous page is wheeled over a greenhouse and its forty-eight 1,000-candlepower electric lamps are set in operation

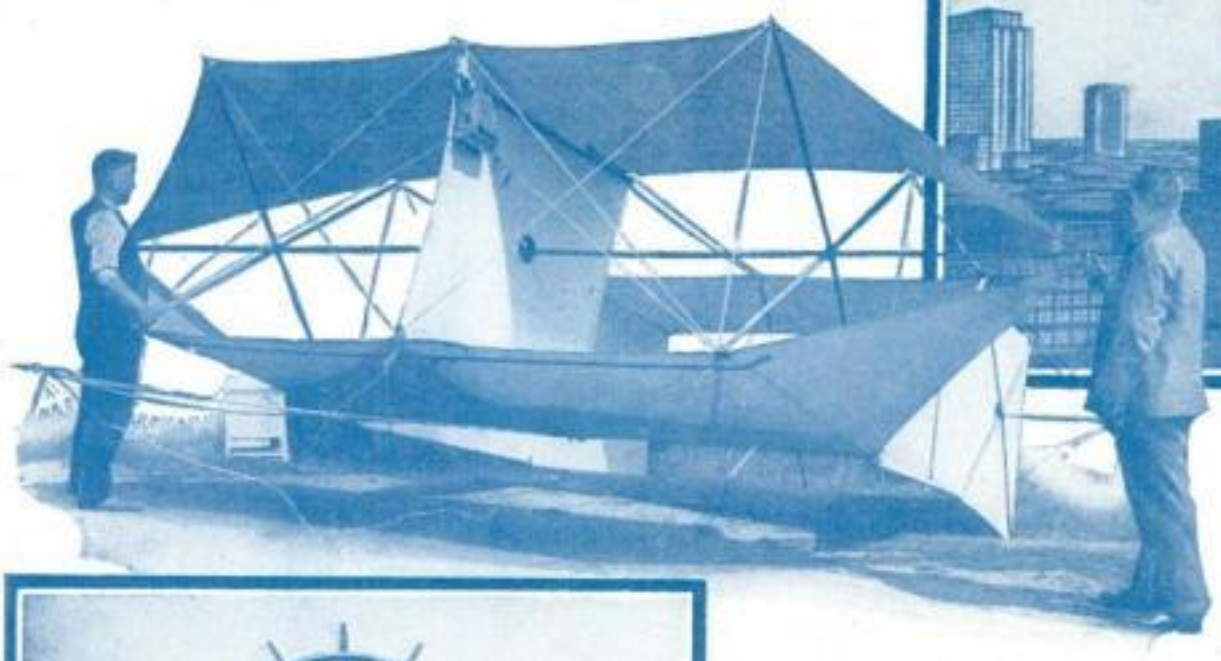


This experiment is designed to discover the effect of illuminating gas on a growing rose. In a short time the petals begin to fall off, the leaves wither, and the plant dies. Dr. P. W. Zimmerman is conducting the test

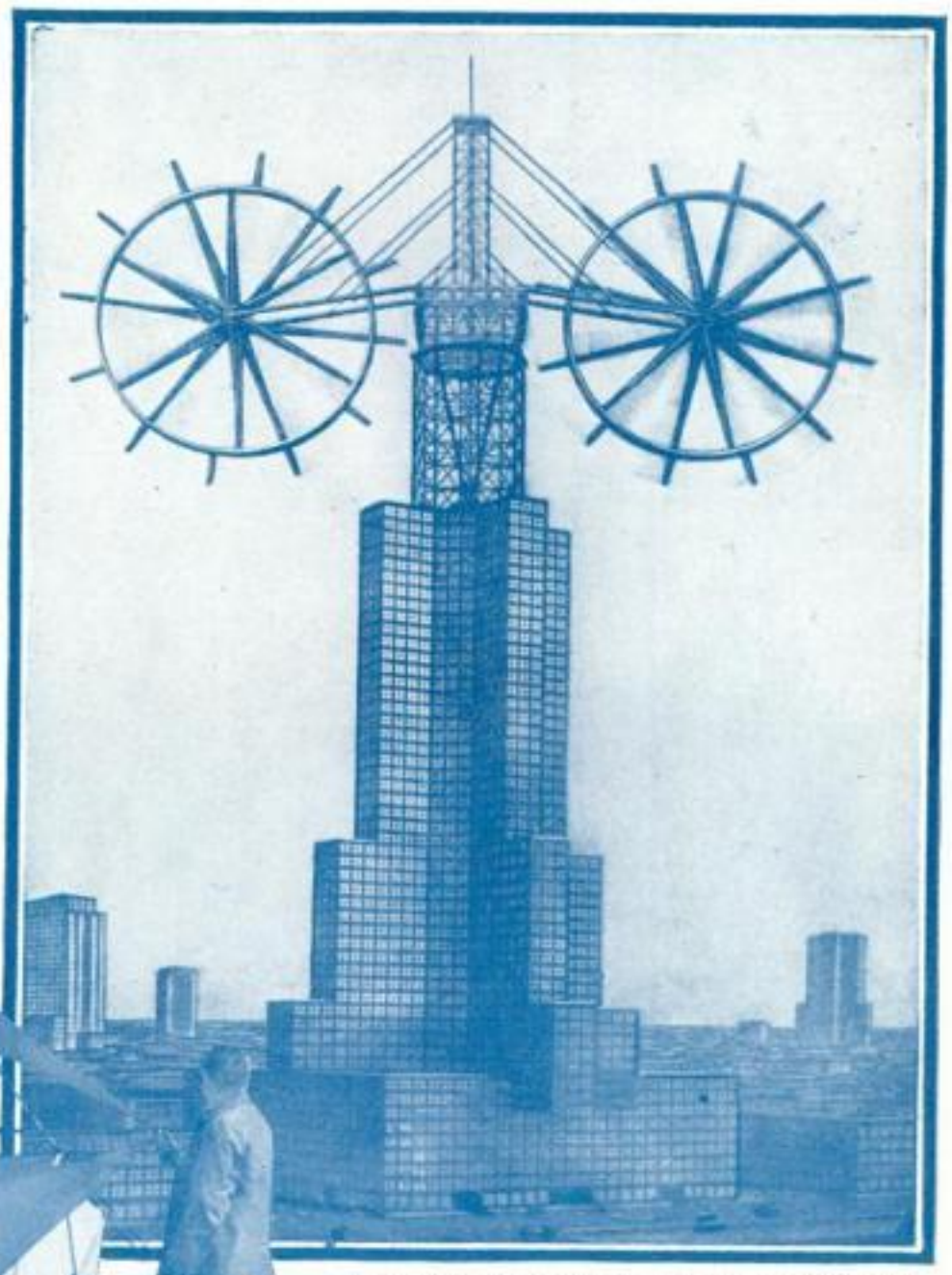
Skyscraper Windmills to Harness Air for Power

WILL "skyscraper windmills" open the way to a new era of cheap electric power? This is the suggestion made by Hermann Honnef, German structural engineer. To tap the power of high winds that blow at great heights above the earth, he has designed a type of windmill the dimensions of which all but stagger the imagination. Its 1,400-foot tower would top New York's Empire State Building by a dozen stories. For vanes, it carries a pair of wheels with spokes like airplane propellers—each wheel 524 feet in diameter, or the length of two city blocks! When they turn at their estimated speed of seven and a half revolutions a minute, the rims are traveling at 142 miles an hour. Electric dynamos, with casings large enough for a man to walk through, are to be mounted at the hubs. If more power is needed, three pairs of wheels may be used. A "three-wheeled" tower, costing a million dollars to erect, would supply the electric needs of a city of 100,000 inhabitants, Honnef estimates, at a cost comparing favorably with steam and water power. He visions the first application of skyscraper windmills, however, in remote lands where fuel is transported with difficulty.

Speaking as an experienced builder of towers, for he designed and erected an 850-foot radio tower near Berlin and other tall structures, Honnef sees no obstacle to the building of giant windmills. With a framework of massive steel pipes electrically welded, such a windmill would be sufficiently strong with a minimum of weight.

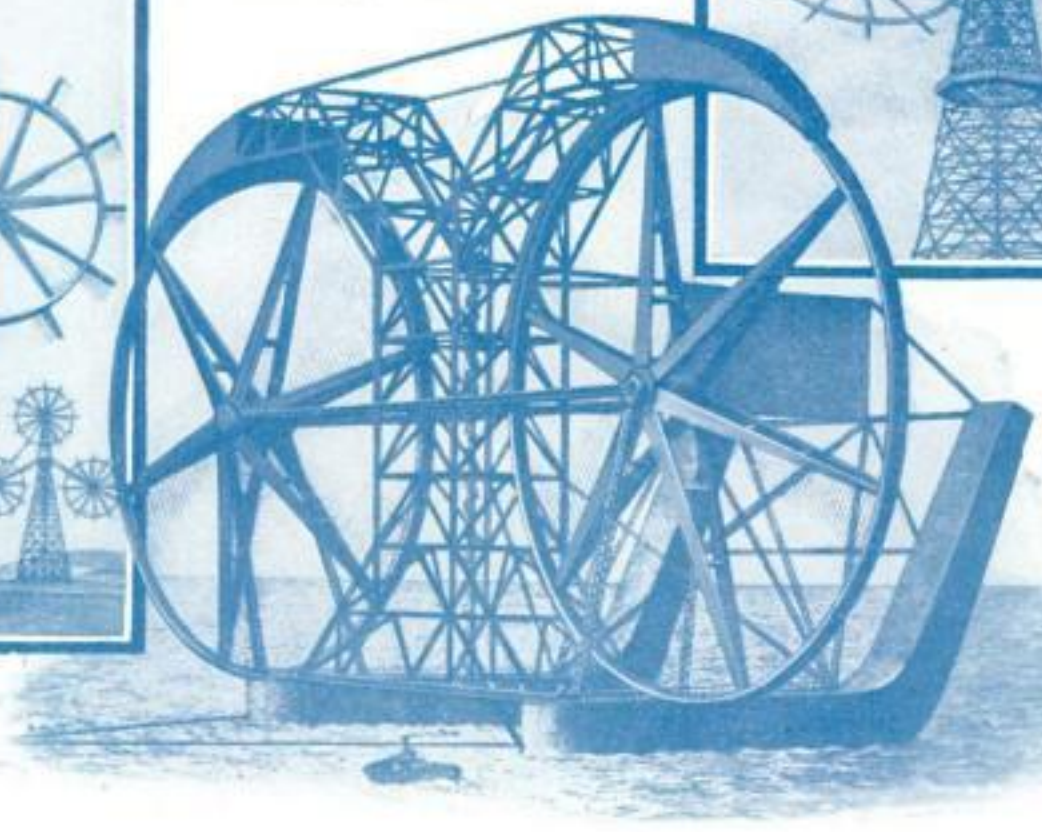


Hermann Honnef, left, sending up a kite with instruments to test wind velocity at various levels. Below, a windmill-like ocean station that could manufacture hydrogen gas electrically from sea water



Windmills, on towers that would dwarf our present tallest buildings, are proposed to tap the power of gales high above the earth. Dynamos in the hubs of the wheels would generate current

In desert regions, far from coal or oil, great windmills would supply power to run electric plants and thus open such inaccessible places to colonization. Above is the design for a three-wheeled windmill for pumping water



If the power of the wind threatened to sweep the big windmill wheels away, an automatic release would permit them to turn on their sides until only the edge met the gale

CRASHES PLANE IN 400-FOOT DROP TO TEST SAFETY CABIN

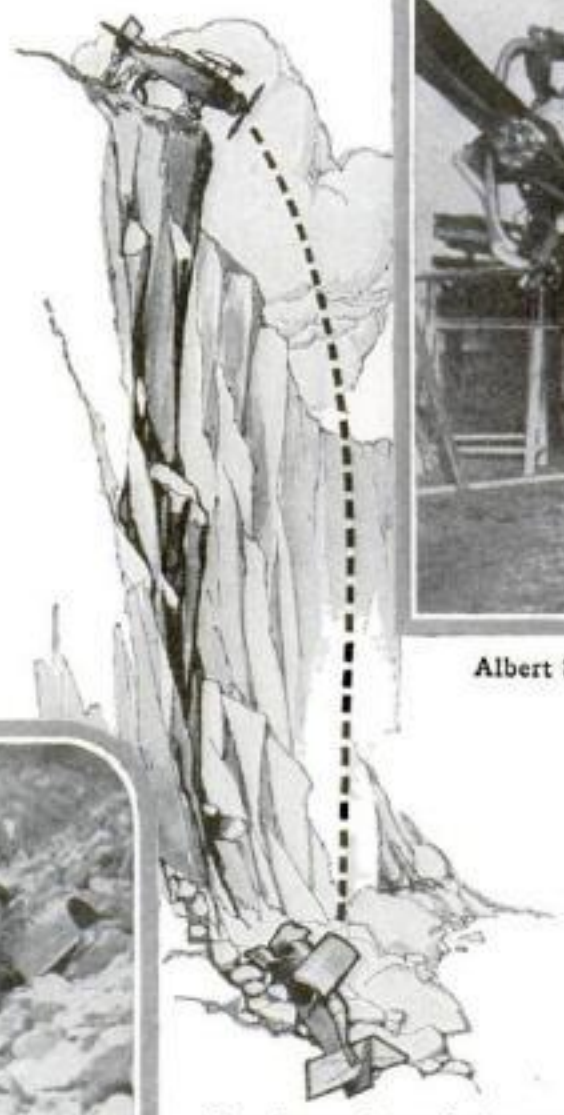
A YOUNG French engineer eluded police the other day and had himself pushed over a precipice in a spectacular demonstration of a crashproof plane that he had invented. He called the experiment a success, for though the machine was demolished, the daring inventor clambered without a scratch from the wreckage.

For five years, Albert Sauvant, of Grasse, France, has been perfecting the shock absorbing principle that he expects will protect aviators in forced landings. Not long ago he built an airplane incorporating the idea, but police intervened when he sought to test it, declaring he would be committing suicide. Even when he caused a model of his invention to crash with a lamb as its only passenger, and the lamb escaped unhurt, the authorities were not convinced.

Albert Sauvant and his safety plane before the crash test

Recently, however, Sauvant secretly carried his model to the edge of a 400-foot cliff near the town of Escragnoles, climbed in, and persuaded friends to shove him over the brink. His escape, he declares, vindicates his shock-absorbing principle.

He compares the operation of his device to the experiment of dropping an ostrich egg within which has been placed a hen's egg. The outer shell is broken, but the hen's egg remains intact. Similarly, Sauvant's plane employs a double-walled cockpit, its inner shell being equipped with oil-filled shock absorbers. Sauvant asserts that a plane so equipped might fall 3,000 feet without injury to the pilot.



How the crash-proof plane was tested in a fall from a 400-foot cliff. Left, the fall smashed the plane but the inventor came through without a scratch

NEW ICE-PACKED PLATE TAKES PHOTO IN DARK

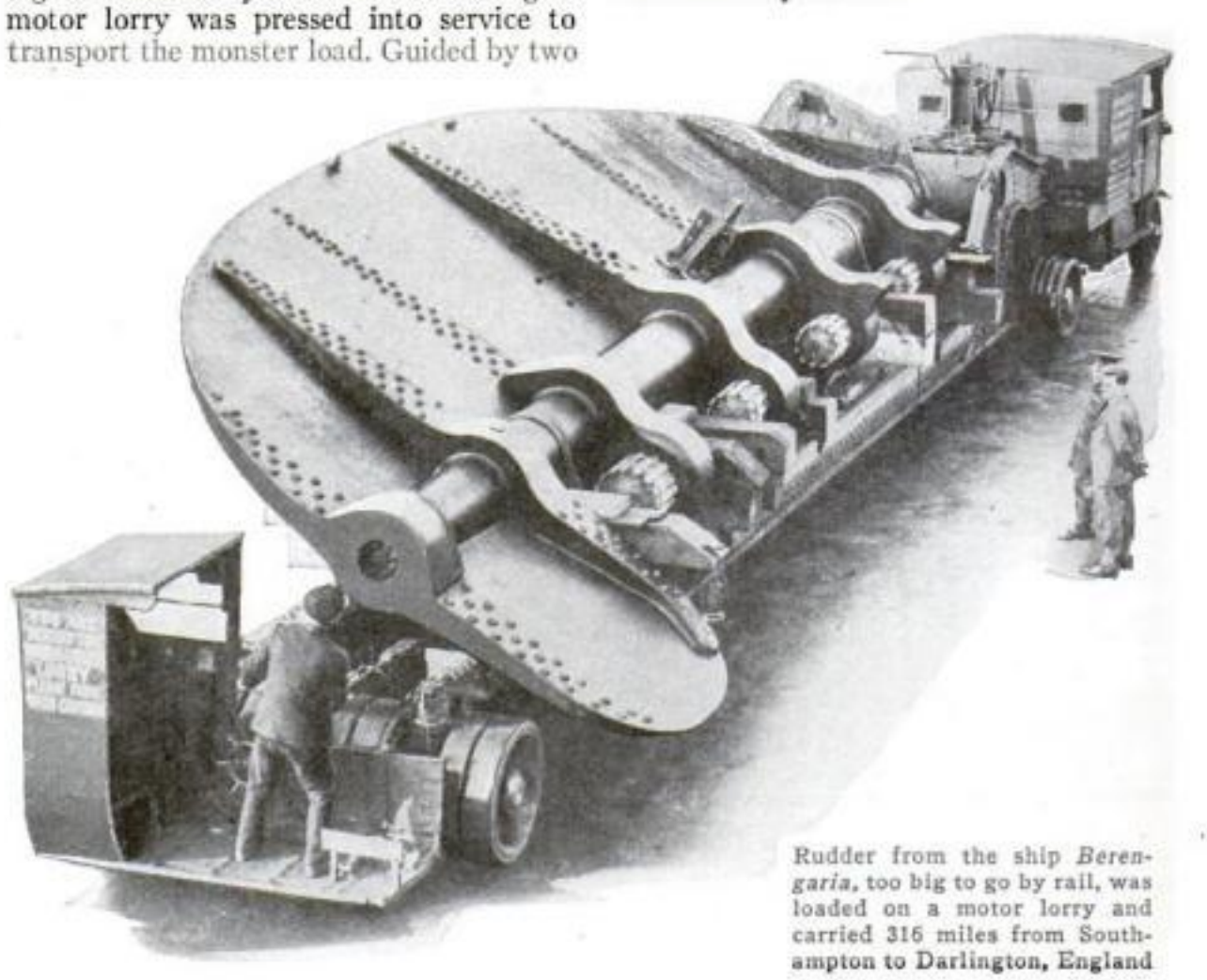
PHOTOGRAPHING a warm flatiron in the dark, with the aid of new plates sensitive to heat rays as well as to light, was a feat recently accomplished by a Carnegie Institution physicist. The special plates must be kept packed in ice until ready for use. The picture above at left was taken in total darkness and the one at right in full daylight.

VITAMIN C ISOLATED

VITAMIN "C," the health-giving substance in citrus fruit, has been isolated. Announcement that he had concentrated it from lemon juice, after five years of labor, was made recently by Dr. C. C. King, young University of Pittsburgh chemist. This vitamin prevents scurvy, and its isolation is an invaluable aid to the study of the human body's chemical reactions.

SHIP'S GIANT RUDDER RIDES ON TRUCK

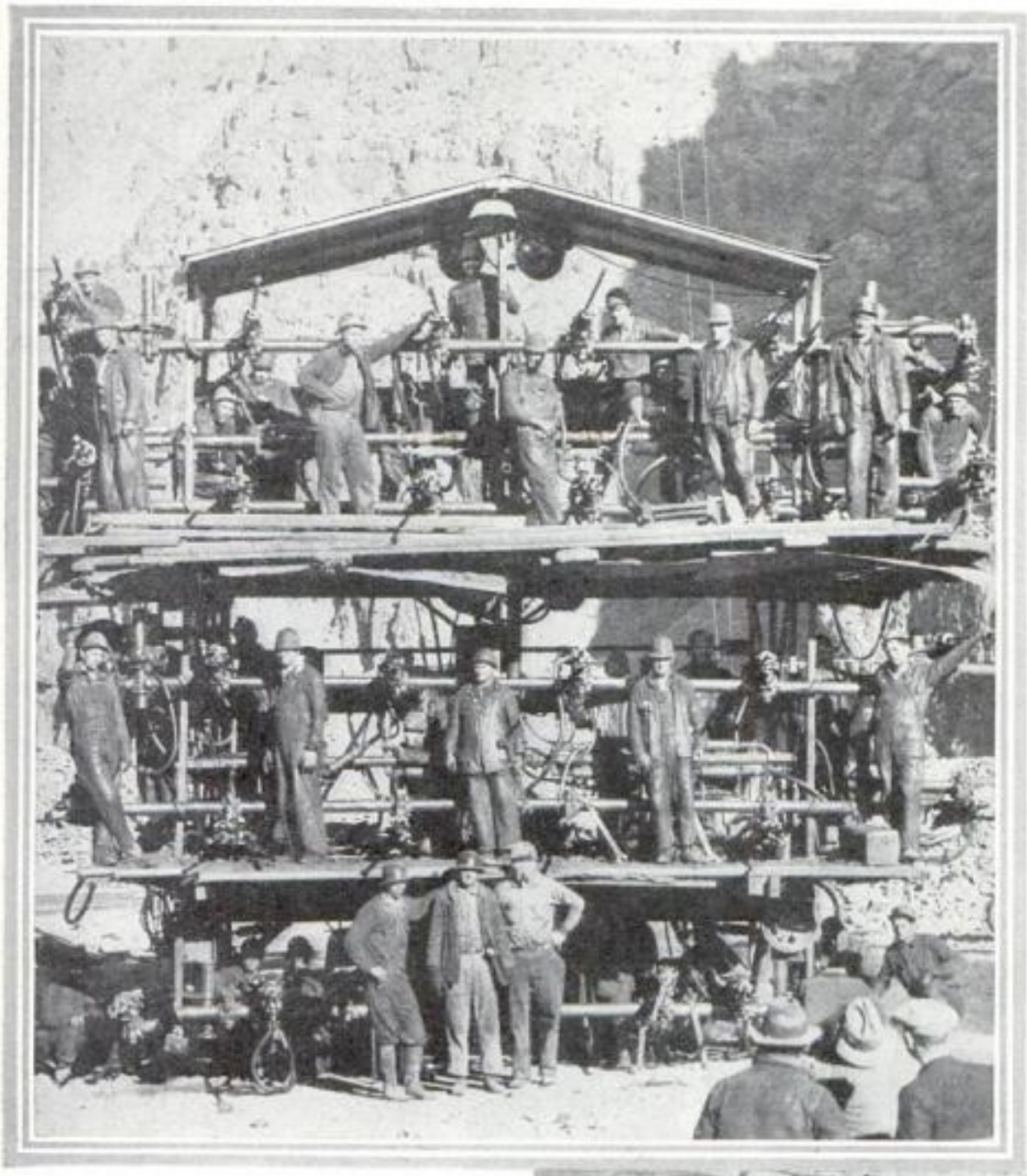
WHEN the fifty-five-ton rudder of the S.S. *Berengaria* had to be shipped for repairs from Southampton to Darlington, England, the other day, it was found too big to be carried by rail. The world's largest motor lorry was pressed into service to transport the monster load. Guided by two drivers, at front and rear, and carrying a sign appealing to motorists in the rear to be patient, it successfully negotiated the 316-mile cross-country journey with its unusual and unwieldy burden.

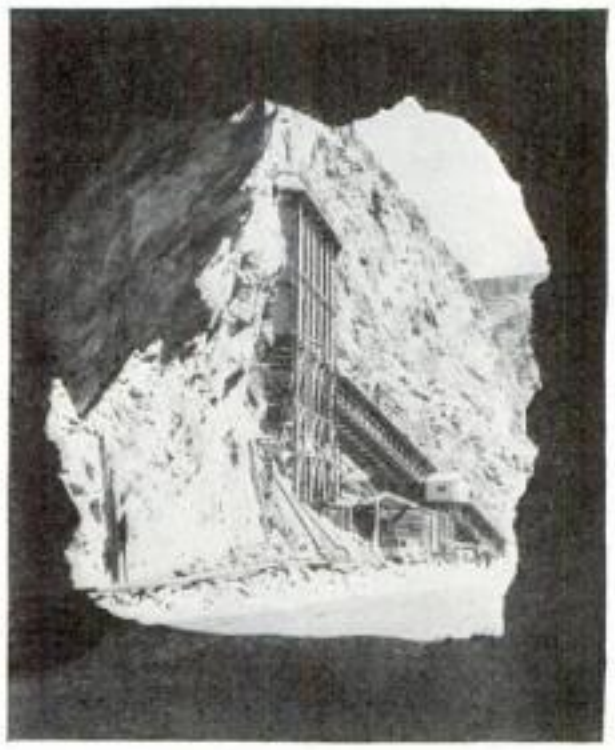


Rudder from the ship *Berengaria*, too big to go by rail, was loaded on a motor lorry and carried 316 miles from Southampton to Darlington, England

Mighty Machines Speed Work on Hoover Dam

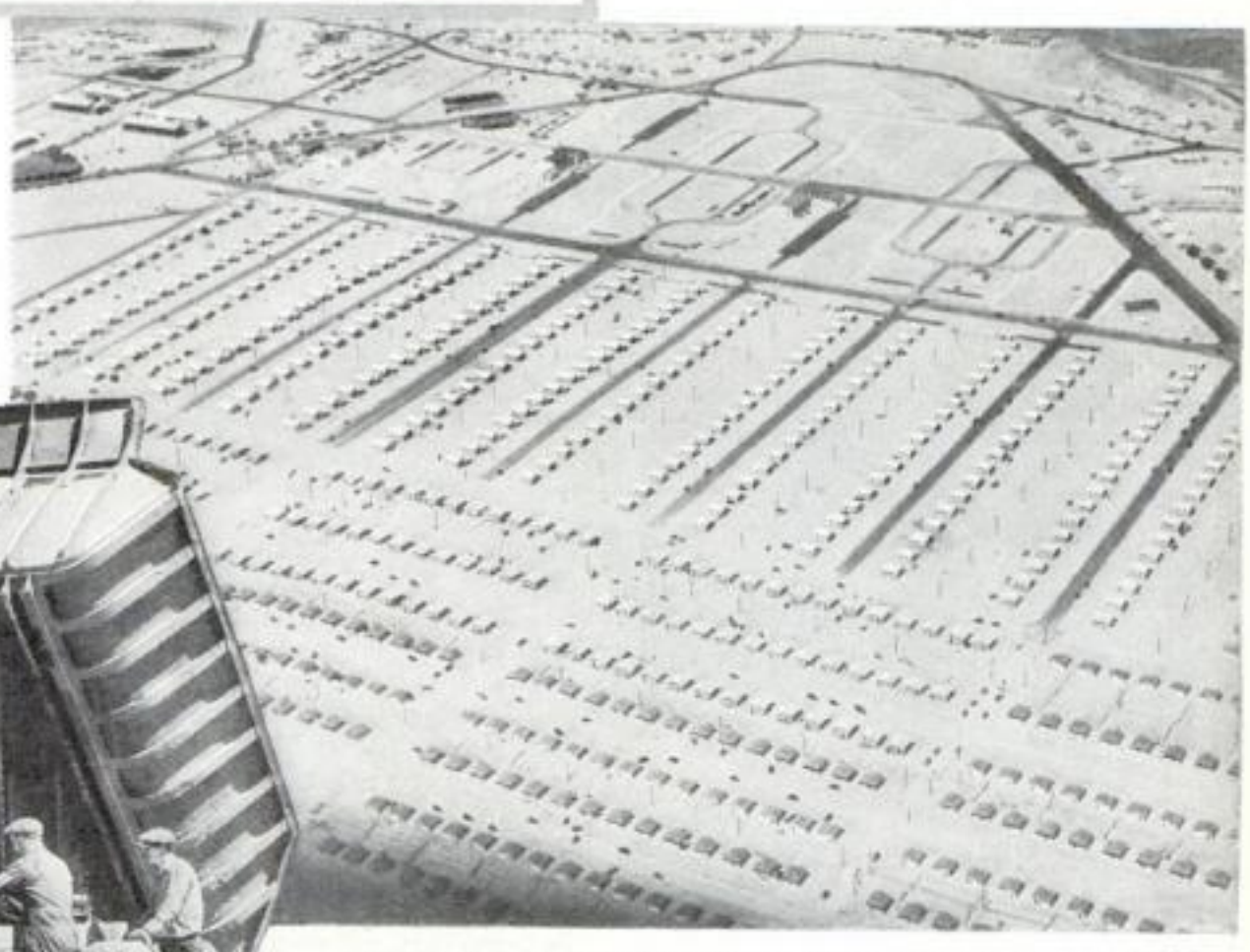
PROGRESS made to date virtually assures the success of one of America's boldest engineering projects—turning the Colorado River from its course and bottling it up in four mighty tunnels through rock cliffs, at the point where Hoover Dam soon will rise. Once the river is out of the way, engineers will proceed to raise the world's loftiest dam, a sheer concrete wall that will tower 730 feet above the dry bed. When the waters are turned back from the tunnels, they will be harnessed for power and irrigation. The fifty-foot-diameter tunnels are being pierced with the aid of such remarkable machines as the sixty-four-man "jumbo" at left.





"JUMBO" AND HER CREW THAT DIG TUNNELS FOR A RIVER

Sixty-four men operate this giant machine that is used to dig thirty-two holes at once, for blasting charges, in the work being done at Hoover Dam. With it, four tunnels will be scooped out and through these the Colorado River will be diverted while the great dam is being built. The helmets worn by the workers guard them against rock fragments



Upper right, a view of the largest concrete mixing plant in the world. Here 3,000,000 cubic yards of concrete will be mixed for Hoover Dam. Above, air picture of Boulder City where 5,000 workers now live

At left, one of the trucks used in construction work at Hoover Dam. Note the canopy of wire netting that is raised over the truck to protect driver from injury by falling rocks

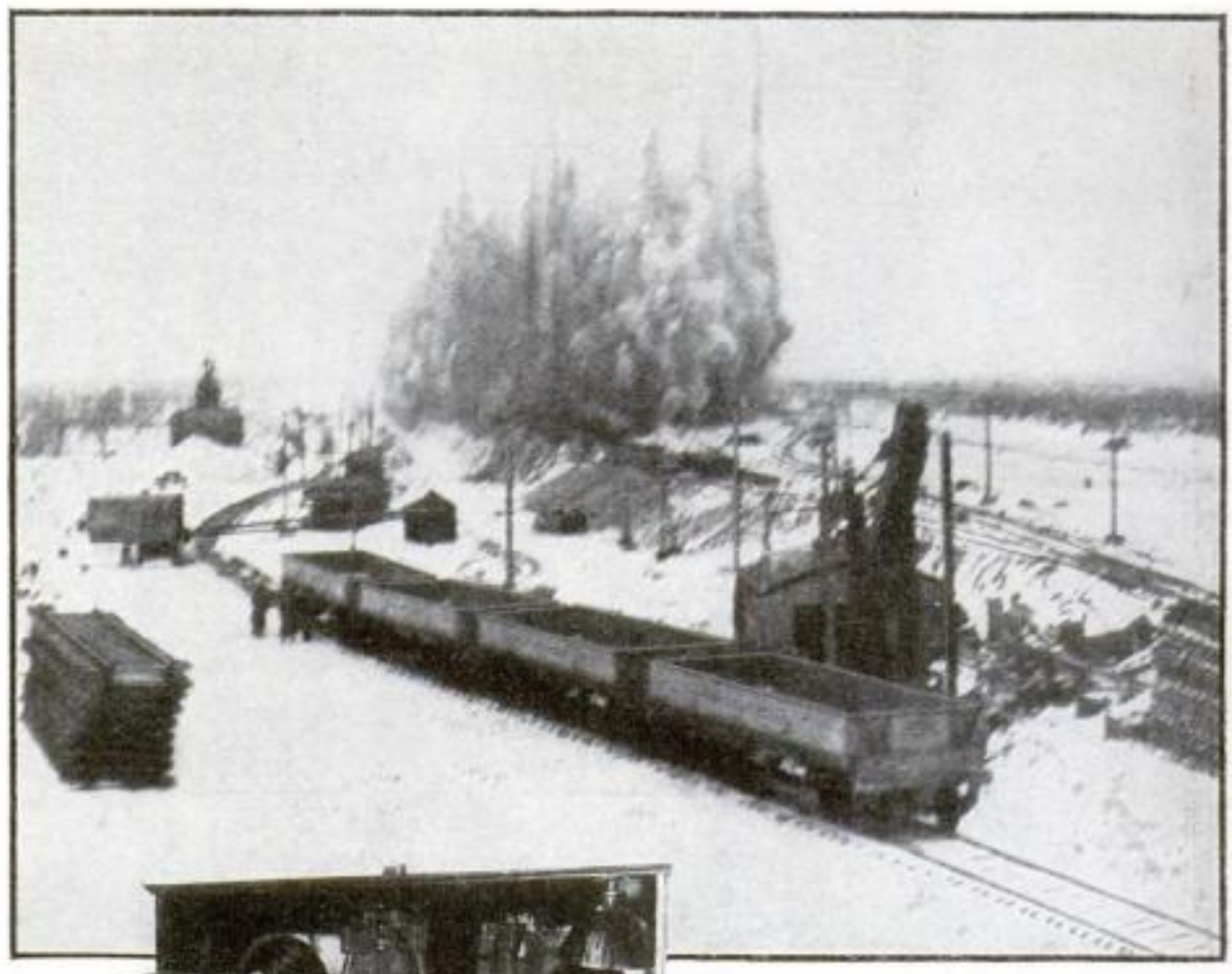
NEW ROBOT CAMERA IS DANCE PARTNER

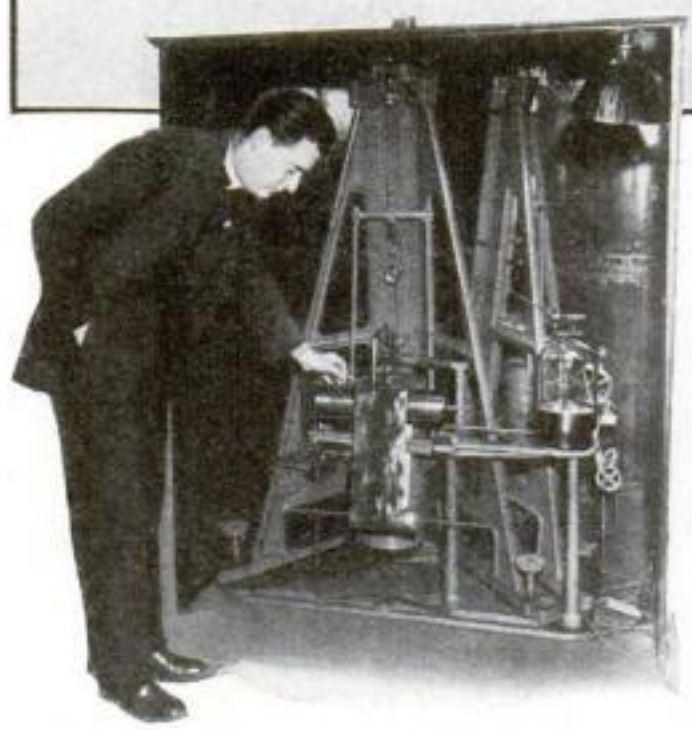
A MOVIE camera that bobs up and down in the motions of a dance has been introduced for realistic close-ups in ballroom scenes. Cams in the automaton's rubber-tired wheels may be adjusted for a waltz, foxtrot, or tango, and the actress goes through the steps in the robot's wooden arms. It is powered by electric motors.

PHONOGRAPH RECORDS SELECTED BY PHONE

CUSTOMERS of a British dealer in phonograph records now choose their purchases by telephone. The enterprising merchant fitted a talking machine with an electric pick-up and amplifier, and plays over the selections before a telephone fitted with a hornlike transmitter. The telephone subscriber then places his order for the desired records.

BLAST IN QUARRY FELT 600 MILES AWAY





Following the detonation of 445,000 pounds of explosive in Michigan, the seismograph at Georgetown University, Washington, D. C., 600 miles away, caught the vibrations

Below, tamping explosive into 5,000 drill holes in quarry and, above, a picture made at the instant the record blast was fired

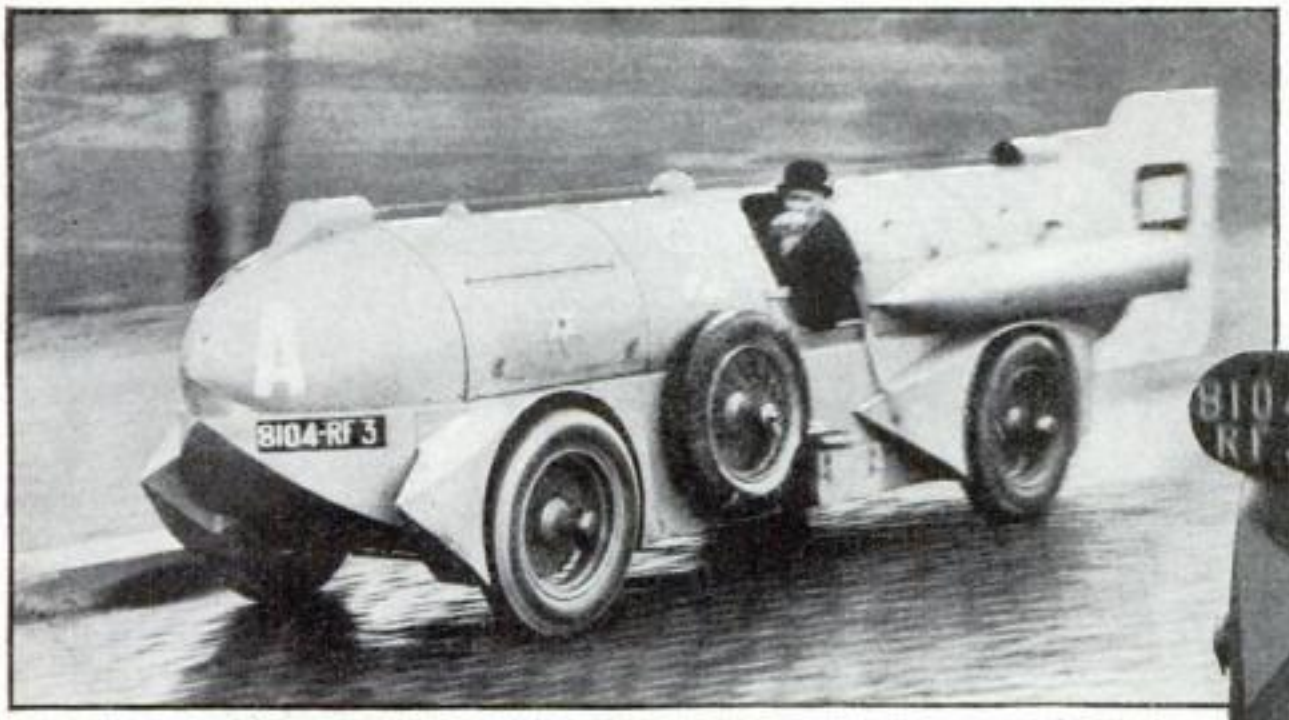
WHEN America's biggest blast was set off a few weeks ago in a quarry at Manistique, Mich., to shake down a whole year's supply of limestone at once, scientists took advantage of the opportunity to study the speed at which earthquake waves travel through the earth's crust.

Barricaded in a steel shelter, E. J. Brown of the U. S. Coast and Geodetic Survey was official timer for the mighty explosion. When he saw a column of rock and smoke fly toward the sky, he pressed a lever that recorded the exact time, 3:02 P.M., on an instrument preset with time signals from the U. S. Naval Observatory.

Throughout the country, observers waited at their earthquake-recording seismographs for the shock. Twenty states were jarred with all the effect of a real temblor. Madison, Wis., reported the artificial quake two minutes after it was touched off. It struck Buffalo, N. Y., in four minutes. The seismograph at Georgetown University, Washington, D. C., picked up a faint tremor after five minutes, indicating that the waves traveled the intervening distance at more than hundred-mile-a-minute speed.

This 600-mile-away detection of an artificial explosion was thought to constitute a record. Figures illustrating the magnitude of the blast were revealed by Hercules Powder Company engineers, who coöperated in planning it.

FRENCH "METEOR" AIMS AT NEW SPEED RECORD ON LAND

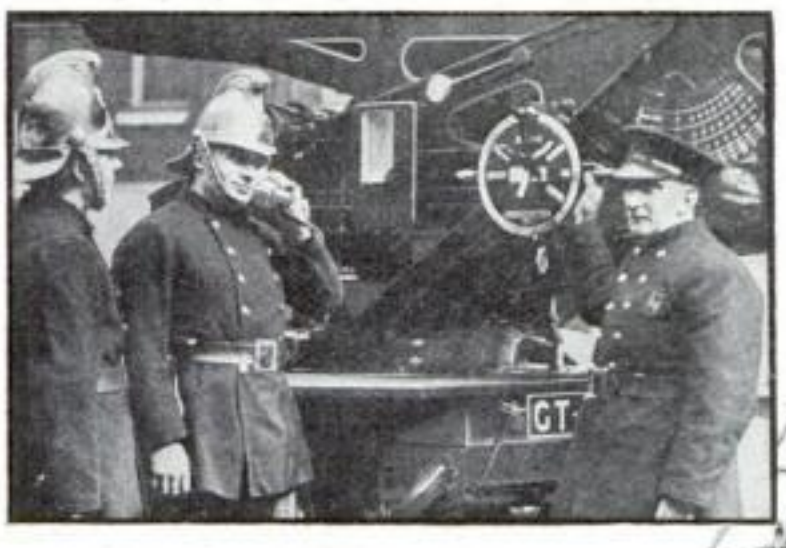


"Meteor" auto, designed to be world's fastest car, on trial spin through outskirts of Paris

A STRANGE car nicknamed the "meteor automobile," because of the long flames that spout from exhaust ports at its rear, has been built in France for an attempt upon the world's speed record. The three 800-horsepower motors that drive it have been transformed into motor turbines, according to reports, and calculations give the car a potential speed of 360 miles an hour, more than 100 miles an hour faster than the 253-mile mark set at Florida last February by Sir Malcolm Campbell, British racer. A sixty-horsepower motor is used to start the big blue car.

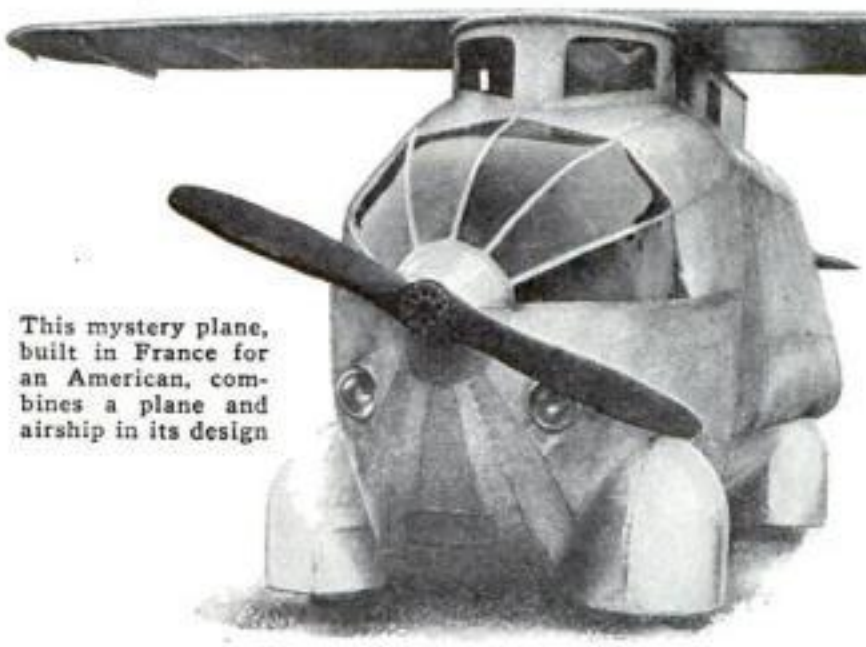
When the "Meteor" runs at full speed, long flames shoot from these exhaust ports at rear of car that may go 360 miles an hour

ORDERS PHONED UP HIGHEST LADDER



SO TALL is a rescue ladder recently put into service by firemen of London, England, that a telephone is used to maintain communication between those at the top and bottom. Fully extended, it is 104 feet, and is said to reach twenty feet higher than the types now in use. The men at the base may follow the progress of the rescue work by phone.

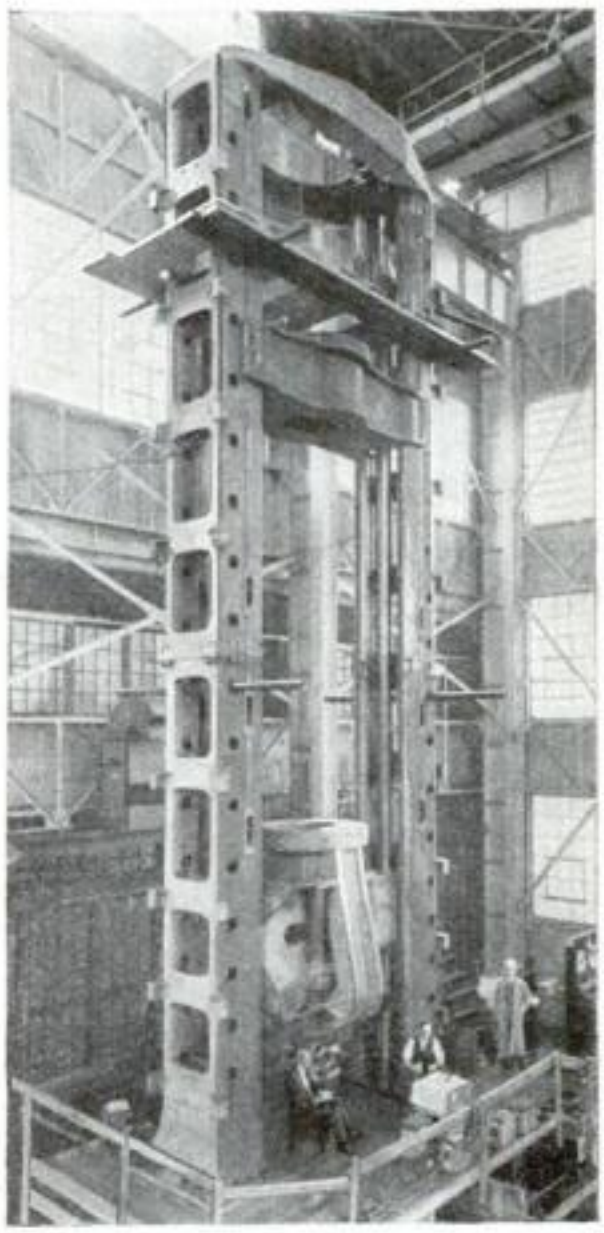
Orders are phoned up this 104-foot fire ladder



This mystery plane, built in France for an American, combines a plane and airship in its design

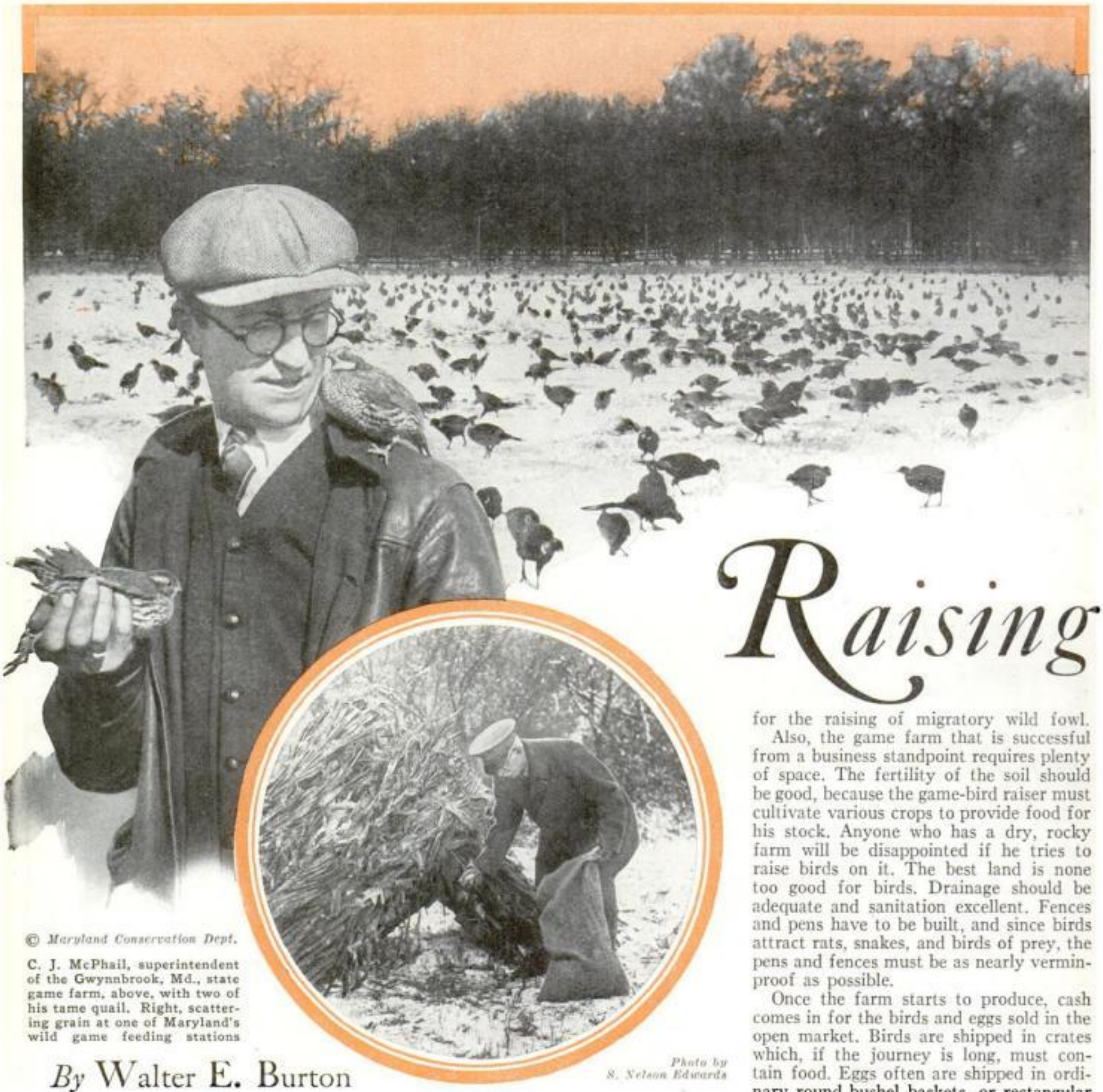
MYSTERY PLANE IS HALF AIRSHIP

CALLED the "mono-dirigible," a mystery airplane was recently completed in France for Frank Bolger, American aviator. Its secret construction is reported to make it a hybrid between an airplane and a dirigible. Propellers are mounted fore and aft on the all-metal body. The machine is to be shipped to the United States for an air tour.



GIANT TESTING MACHINE

EIGHT-INCH columns of solid steel are snapped off like match sticks in a giant testing machine just installed at the University of California. The massive jaws, that can exert a 4,000,000-pound push or pull, were carried on an eight-wheel trailer through the streets of Oakland and Berkeley, Calif. It will test the material for the projected San Francisco Bay Bridge.



© *Maryland Conservation Dept.*

C. J. McPhail, superintendent of the Gwynnbrook, Md., state game farm, above, with two of his tame quail. Right, scattering grain at one of Maryland's wild game feeding stations

Photo by S. Nelson Edwards

Raising

By Walter E. Burton

RAISING game birds for the market is rapidly becoming a big business in the United States, and one that is bringing real profit to those engaged in it. Though some of the largest game bird farms in the world are in this country, the market readily absorbs the entire output.

Zoos and fanciers purchase hundreds of birds each year for exhibition purposes. State game departments and sportsmen's organizations constitute a large market, buying them to restock areas in which the birds are scarce or extinct. There is also a demand from other breeders for additional stock, and if there is a surplus it is readily absorbed by clubs, hotels, and restaurants. It is probable that, within a short time, quail, pheasant and partridge will be raised for the food market on a scale comparable to the present poultry industry.

Development of better food stock may be expected. This in turn probably will lead to the bootlegging of wild birds. But in spite of that contingency the prices are sure to remain good, and the profits to the raiser will continue satisfactory.

Bobwhite quail, ringneck pheasants, various fancy pheasants, Hungarian partridges, grouse, wild turkeys, wild ducks, wild geese, and peafowl have all been successfully raised in captivity. Just now the ringneck pheasant leads the popularity list because it is in great demand by sportsmen. However, the quail, whose commercial propagation was, until a few years ago, thought impossible, is climbing rapidly to a point near the top.

But whatever birds are raised there are certain general conditions that must prevail at every game farm. Such a farm must be operated in conformity with state and Federal laws and regulations. Most states require breeders of birds to take out licenses, and a Federal permit is needed for the raising of migratory wild fowl.

Also, the game farm that is successful from a business standpoint requires plenty of space. The fertility of the soil should be good, because the game-bird raiser must cultivate various crops to provide food for his stock. Anyone who has a dry, rocky farm will be disappointed if he tries to raise birds on it. The best land is none too good for birds. Drainage should be adequate and sanitation excellent. Fences and pens have to be built, and since birds attract rats, snakes, and birds of prey, the pens and fences must be as nearly vermin-proof as possible.

Once the farm starts to produce, cash comes in for the birds and eggs sold in the open market. Birds are shipped in crates which, if the journey is long, must contain food. Eggs often are shipped in ordinary round bushel baskets, or rectangular baskets of smaller capacity.

Although pens are used extensively, birds are not always kept in them. Because all game birds are able to fly, it is general practice among bird farmers to clip one wing. When a bird with a clipped wing tries to fly, it loses its balance and falls. Pinioning is another method of preventing flight. This, done when the bird is young, consists of removing the last section or "fingers" of the wing. A bird once pinioned never will be able to fly.

A third flight cure is brailing, a temporary measure that consists of tying the wing with tape so that the bird cannot use it.

Bobwhite quail, well-known in almost every part of the country, are fighting a losing battle with modern civilization. When farmers substituted barbed wire for rail fences and hedgerows, they struck a major blow at the quail by destroying necessary shelter and feeding places. It is

Photos © Maryland Conservation Dept.

The quail, left, were kept in this brood run for eight months before they were permitted to set foot to ground. Below, an electric brooder with a removable tray that facilitates cleaning

This Article Tells How Many Farmers Find Cash Market for Their Partridge, Pheasants, Grouse, and Quail Hatched and Grown in Pens

Game Birds *for* PROFIT

likely that quail eventually will become extinct if the birds are left to their own resources in the struggle for existence. To assure an adequate supply of this popular game bird, various organizations and individuals have studied it intensely.

W. B. Coleman of Richmond, Va., is the acknowledged leader in modern methods of quail raising. His success is reflected by his record of raising sixty birds in 1913 and nearly 7,000 in 1931.

Coleman is associated with Edwin G. Baetjer, a Baltimore attorney who, in 1928, became so interested in the propagation of quail that he purchased a farm near Richmond and set out to eliminate the stumbling blocks that had been causing trouble in the past.

At first, Coleman obtained quail eggs from wild birds and hatched them under bantam hens. Following the hatching, the birds were brooded in manners similar to those employed with chickens or ducks. But trouble developed in the form of disease which was transmitted to the chicks by the bantam hen mother.

IT WAS Coleman who got the idea that, if the hen could be left out of the picture, disease would be reduced greatly. On the Baetjer place, equipped with an electric incubator, Coleman planned and constructed an electrically-heated brooding system. Success was immediate, and 4,069 healthy birds were raised the first year. The electrical system of hatching and brooding has since been adopted extensively elsewhere, not only for quail but also for pheasants and partridges.

The Coleman brooders consist of small sloping-roofed boxes, not unlike dog kennels, mounted on short posts to keep them above the ground. Inside is a thirty-watt heating element that does not give off light. Extending for five feet from each brooder is an exercise run, inclosed in fly-proof wire.

In winter, quail are kept either in the brooder runs or in special winter holding pens. Laying pens consist of frames covered with hardware cloth of half-inch mesh. In one part a small portable shed is placed, so that the birds can seek shelter from wind.

PENS are avoided as much as possible, for quail invariably rise from the ground with a sudden, tremendous burst of speed. If this flight is interrupted by a wire, the birds are likely to be injured.

A quail egg requires about twenty-one days to hatch. Eight or ten hours later, the birds are removed to the brooder. They do not require feeding for twenty-four hours. Then they are started on a clabbered-milk diet, supplemented later with mash, chick grain, and green food.

The ringnecked pheasant is the most popular game bird among raisers. This is due largely to the ease with which it is reared, its hardiness, and its retention of sufficient wildness and wariness to make it an excellent game bird when released for the hunter. It does not mind cold and, in fact, thrives best in the North.

In raising ringnecks there is no such thing as a permanent pen because, occasionally, the inclosure must be moved to a new location, to soil that is fresh and sanitary. This applies even to large pens.

There are two principal systems of pheasant raising now in use, the large pen and the small pen. The large-pen method includes the use of breeding pens 200 by 400 feet or larger, each containing 250 or more birds. Poultry wire is used for the top, and one-inch mesh for sides. Near the bottom a row of boards, the lowest

This hatching and brooding coop has been carefully designed for pheasants, which need the closest attention to sanitary conditions

© U. S. Biological Survey

sunk into the ground, shelters the birds from wind and keeps out vermin. These large pens are used in pairs, so that one can be cleaned and the ground inside it cultivated to provide food while the other is in use. Although one large pen is cheaper than a number of small ones, breeders claim that it results in lower egg production and in fighting among birds.

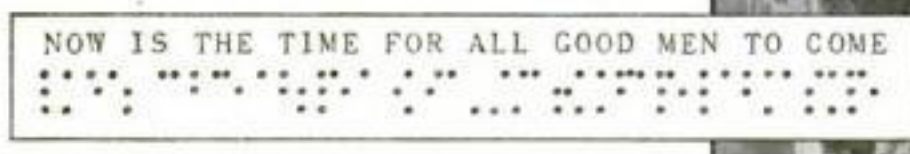
In the small-pen system, breeding pens measure about twelve by sixteen feet on the ground and seven feet high. Hatching and brooding of baby pheasants take place in coops so constructed that the mother bird is held captive while slits can be opened to permit the young ones to leave the coop. These coops are arranged in rows so that exercise runs are formed between them. They must be moved frequently to fresh ground.

Combination hatching coops and exercising runs also (Continued on page 118)

Electric Eye Sets Type Rapidly Without Aid of Human Hands

HIGH-SPEED typesetting without the intervention of a human hand is forecast by the recent demonstration of an automatic linotype machine. Controlled by an electric eye, it transforms typewritten "copy" directly into lead type. The only limit to its speed is said by its Charlotte, N. C., inventor to be that of standard linotype machinery. Copy for use in the automatic typesetter is written upon a special typewriter, which prints a symbol composed of from one to six dots beneath each letter and space. The letters are only for the guidance of writer and editor, for the dot symbols alone actuate the typesetter. Each symbol has been chosen to represent a certain letter. When a sheet of this copy is fed into a special carriage that replaces the usual linotype keyboard, an electric eye scans the lines of dots. Each symbol, according to the number and pattern of dots, actuates the proper lever that sends the corresponding letter of type sliding from the type magazine into place. The lines of type are then cast into slugs in the conventional manner.

Below, the special typewriter to prepare copy for the typesetting machine, operated by electric eye. Dots actuate the "eye"



The copy written on the special typewriter is fed into this typesetting machine and comes out in lines of type

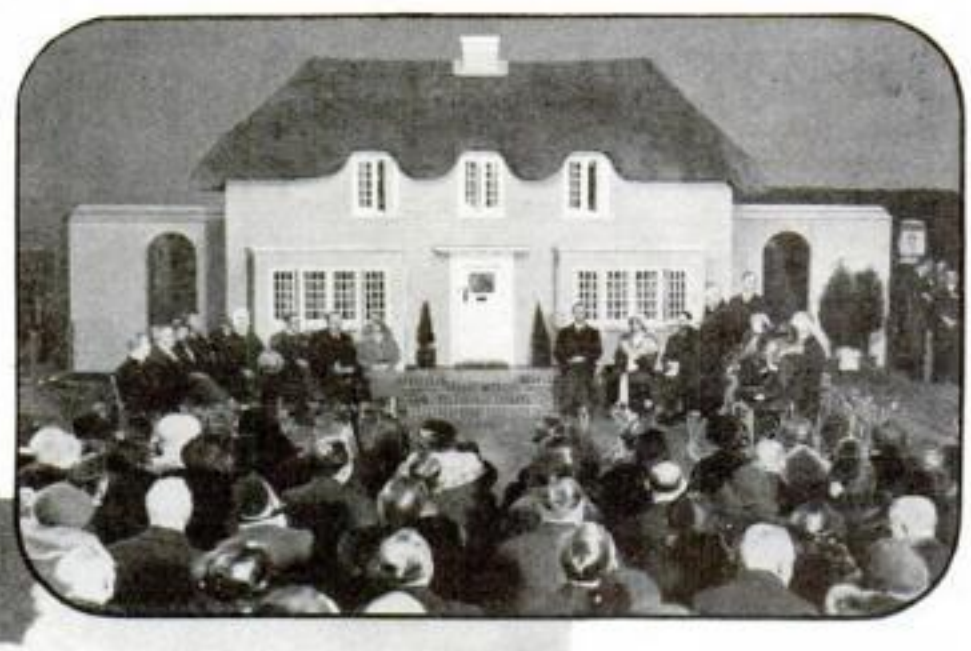
Electrodes at sides of this boy's mouth were connected to recorder to measure electricity generated by his jaws when eating cake

YOUR JAWS GENERATE ELECTRICITY

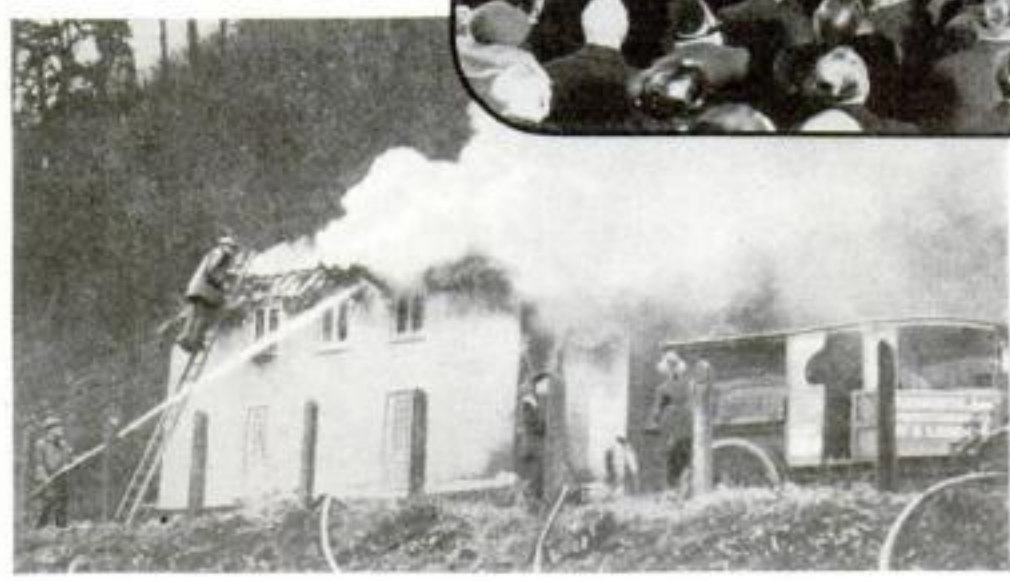
WHENEVER you eat, your moving jaws generate a minute electric current. This was demonstrated when the engineers in a New York broadcasting studio detected and measured the electricity produced by eating cake. A page boy gladly volunteered for the experiment. Two electrodes of German silver were attached to each side of his mouth, and connected to a sensitive recording instrument. Its pen-and-ink graph showed that at each chew the electrical pressure rose to five one-thousandths of a volt.

FIREMEN SAVE ROYAL DOLL HOUSE

BRITISH firemen were called out recently to fight one of the strangest fires in their experience—a conflagration in a royal doll house. As a birthday present for Princess Elizabeth, daughter of the Duke and Duchess of York, Welsh craftsmen constructed a miniature dwelling complete with furniture and fittings of a full-sized home. The gift was placed on a huge truck at Cardiff, Wales, and was on its way to London when it took fire. Firemen managed to extinguish the flames before it was seriously damaged. Repairs were then rushed so as to have the house ready for the Princess' birthday.



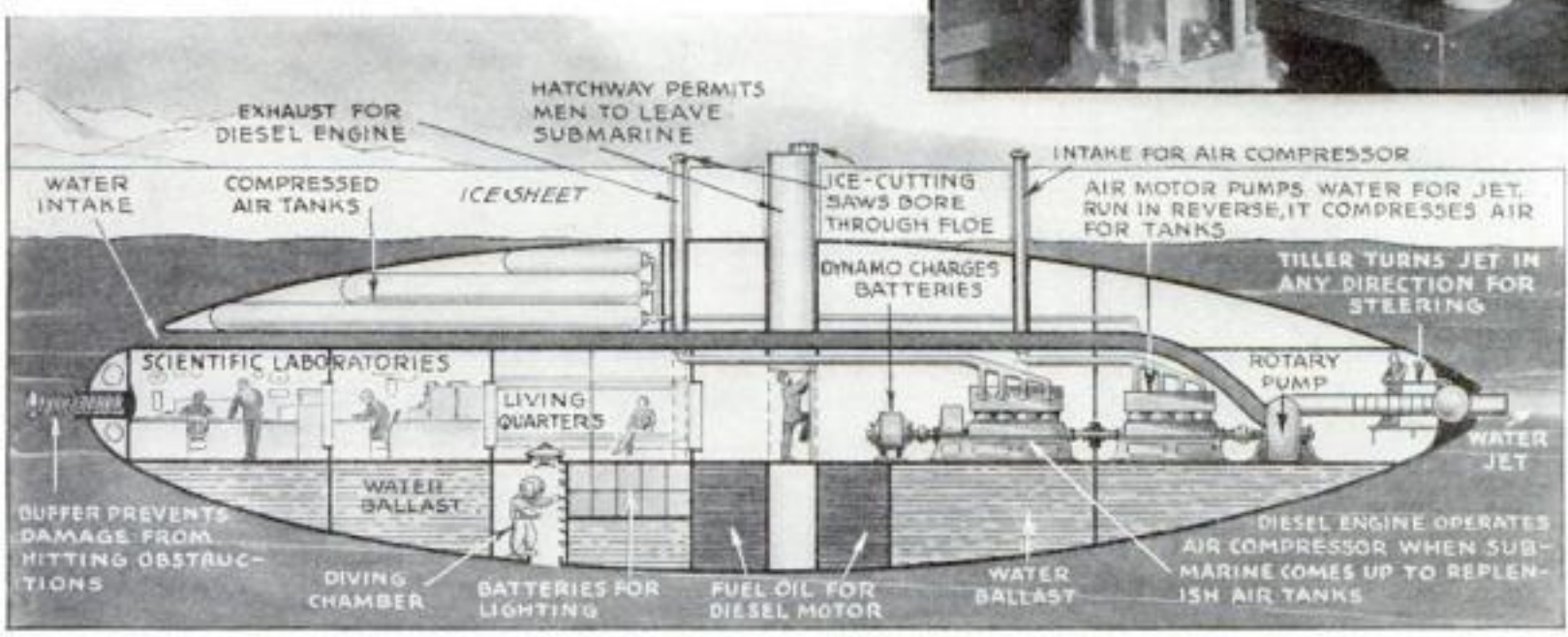
It looks like a real dwelling, but it is simply a doll house built for the little Princess Elizabeth, daughter of the Duke and Duchess of York



While being taken to London the doll house caught fire and firemen were called out to save it from being destroyed

ARCTIC EXPLORER DESIGNS NEW SUB FOR UNDER-ICE TRAVEL

A NEW submarine dash to the Arctic is projected for 1933 by Sir Hubert Wilkins, British explorer, who was dogged by misfortune when he attempted last year to cruise beneath polar ice in a condemned U. S. Navy submarine. He has designed for the venture a remarkable craft that he calls a Squid submarine, and has just revealed the details shown in the accompanying diagram. Like the mollusk from which it takes its name, this odd vessel propels itself by squirting a jet of water rearward. The water is discharged through a flexible nozzle that can be turned in any direction to steer the boat. This dispenses with propellers and rudders, which in Wilkins' earlier venture were damaged by contact with submerged ice. A speed of three miles an hour, the maximum permitting thorough observation of marine life, is planned. Power to operate the water jet is to be supplied by a motor driven with compressed air, and the exhaust from this motor will augment the supply of fresh air for the submarine's occupants.

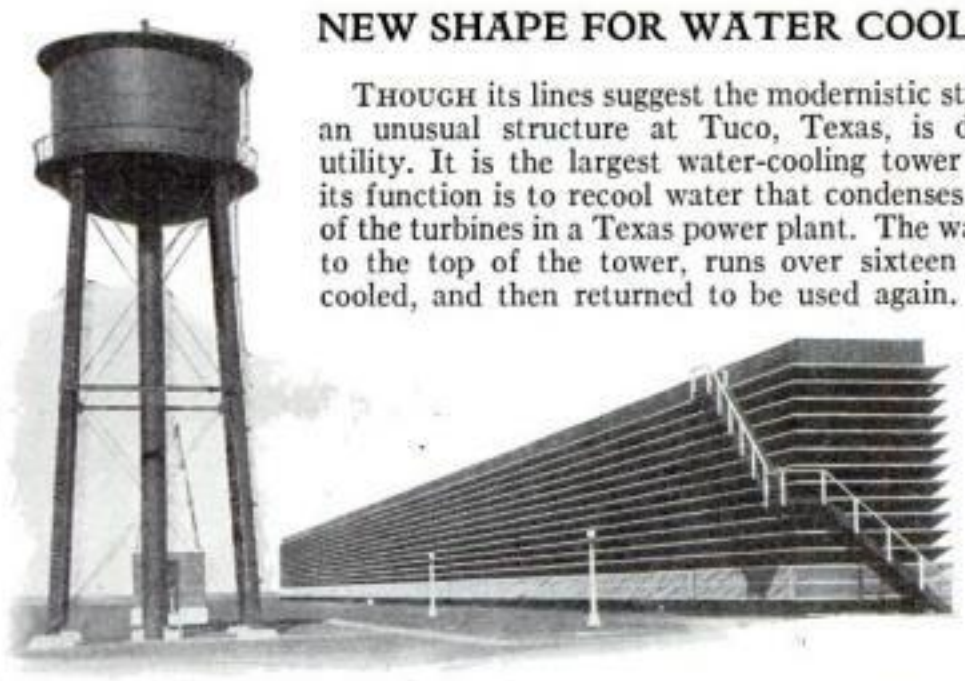


Sir Hubert Wilkins, left, inspects a compressed air motor proposed for his sub by a California inventor

Diagram at left gives details of the strange new sub in which an exploring trip to the Arctic may be made next year

NEW SHAPE FOR WATER COOLING TOWER

THOUGH its lines suggest the modernistic style of architecture, an unusual structure at Tuco, Texas, is designed for strict utility. It is the largest water-cooling tower in the world, and its function is to recool water that condenses the exhaust steam of the turbines in a Texas power plant. The warm water, pumped to the top of the tower, runs over sixteen decks where it is cooled, and then returned to be used again.

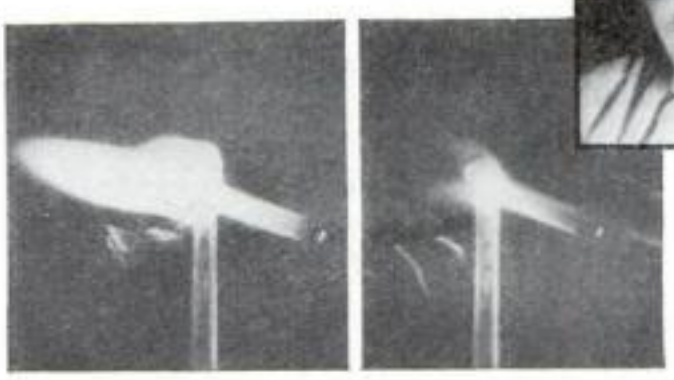


This unusual water cooling tower, the largest in the world, is in use at Tuco, Texas, where it cools water for a big steam power plant

GOGGLES THAT HELP GLASS BLOWERS

GLASS blowers who manufacture apparatus of pipes and tubing have hitherto been hampered by the yellow glare of the incandescent glass. Now goggles have been introduced that eliminate this difficulty. The special glass of which they are made absorbs only the yellow rays. A worker may wear the goggles constantly, as they do not interfere with his vision in performing other duties.

Glass blowers, when wearing special goggles, are not hampered by the yellow glare

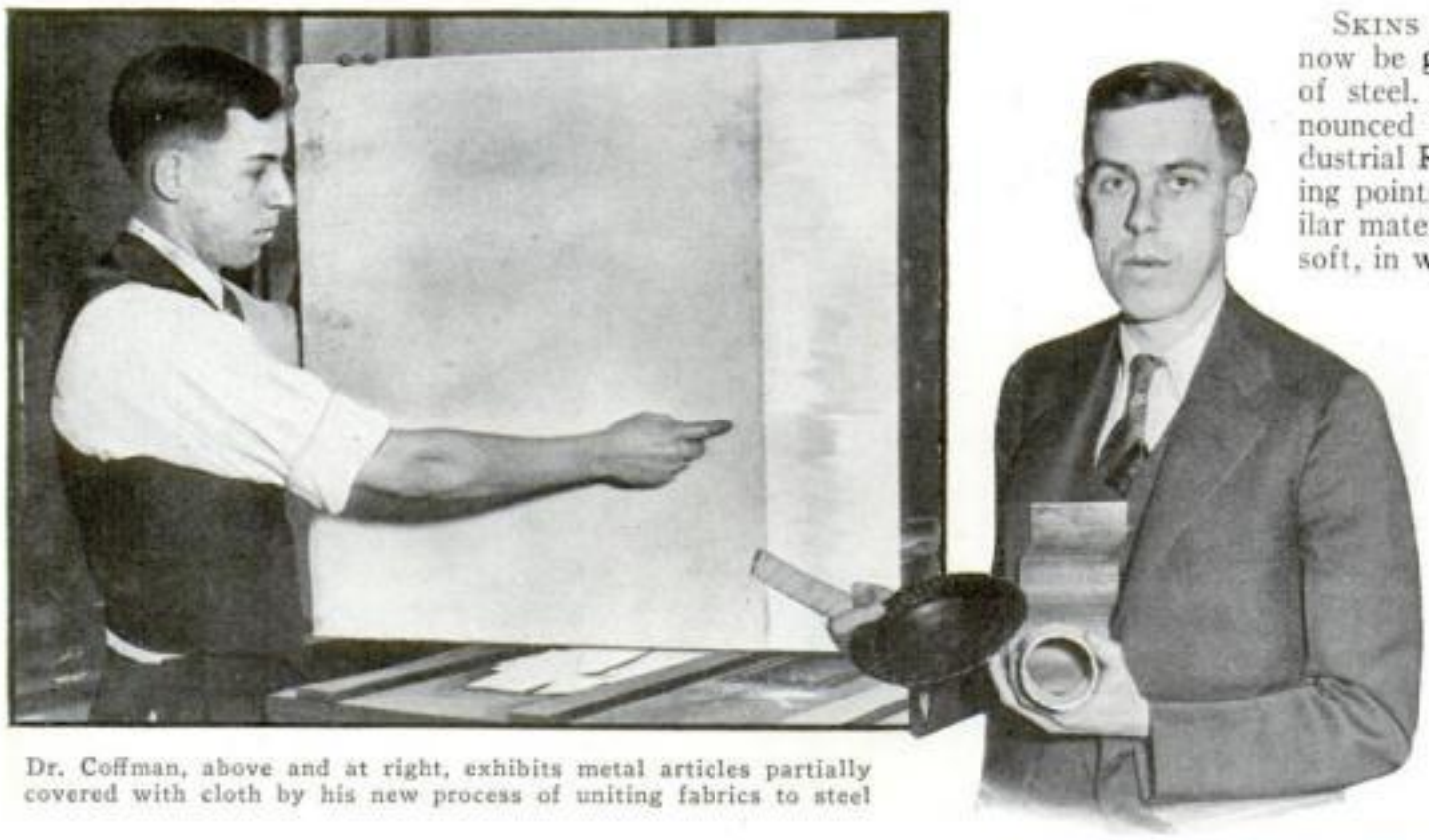


Pictures at left show the glare of glass as seen without goggles and also how it looks when the new lens cuts its brilliance

SHIP GETS POSITION BY EXPLODING BOMBS

EXPLOSIVE bombs were used recently by ocean surveyors of the U. S. Coast and Geodetic Survey to find their position. Two other vessels anchored some distance away at predetermined points picked up the sound of the explosion and instantly relayed it back by radio. By taking into account the speed of sound through water, the explorers knew how far they were from each of the anchored ships and hence could compute their exact position.

Amazing Process Developed to Unite Silk to Steel



Dr. Coffman, above and at right, exhibits metal articles partially covered with cloth by his new process of uniting fabrics to steel

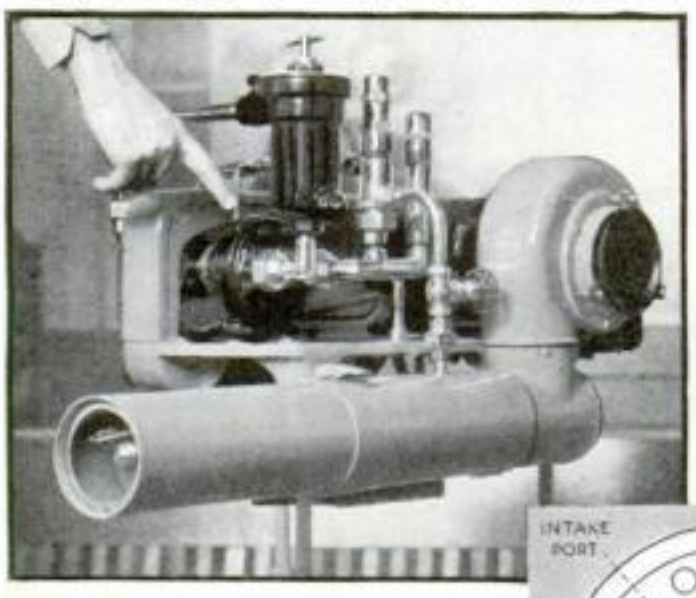
SKINS of silk, felt, and even fur may now be grafted permanently upon sheets of steel. This amazing process, just announced by the Mellon Institute of Industrial Research, uses alloys of low melting points to cement together the dissimilar materials. The alloys are heated until soft, in which state they amalgamate with the fabric and its steel base. Wide industrial applications are foreseen for the new process. Steam pipes covered in this way with asbestos felt will prevent waste of heat. Various linings may be used to protect steel against corrosion, especially in materials for building construction. In the manufacture of small novelties, felt bonded to steel in the new way may be saturated with plastic materials to imitate jewels, silk, and various woods. The coverings may be painted or lacquered.

AIR REAPS STRANGE PLANT

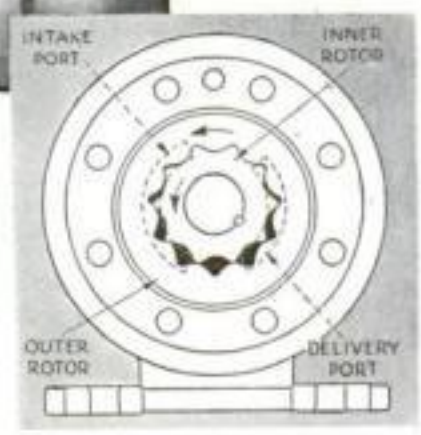
FROM the Mexican plant "broom root," or *zacaton*, come tough fibers that are widely used in the manufacture of brushes. Until recently they were harvested by hand, but now, with the use of American air compressors and pneumatic diggers, the harvest has been speeded up seven-fold. Oxen draw the air compressor on its broad, flat tires to the scene of operations. Using a pneumatic digger with a flat point, one man digs around a plant and loosens it until it can be pried free. A second member of the crew beats the roots to shake earth off, and a third severs them from the upper part.

Left, air compressor and digger reaping "broom root" used in making brushes. Above, the harvested plant laid in piles

TWO ROTORS WORK UNUSUAL NEW PUMP

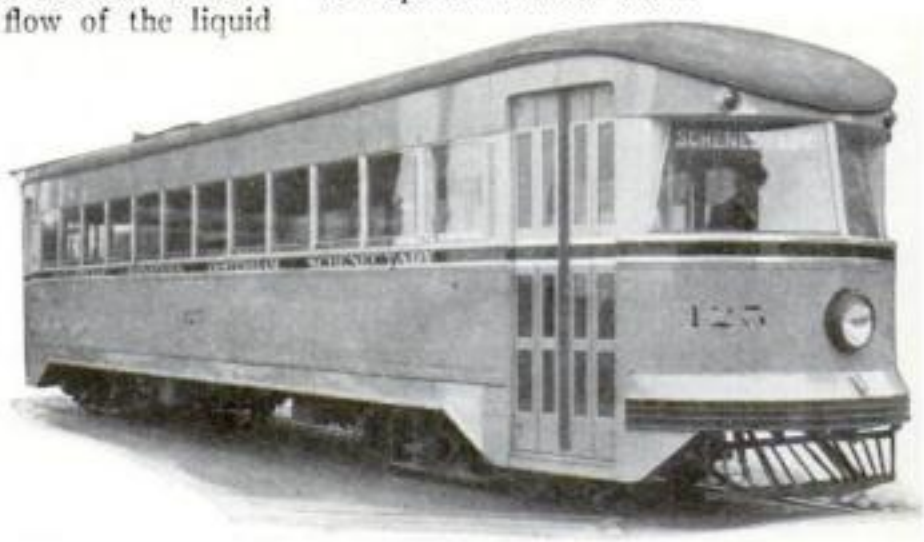


PRACTICAL use of an old mechanical principle is made for the first time in a new pump. Already used upon an oil burner, it may also have important applications in pumping water, milk, and gasoline. The new pump has two moving parts—a revolving disk with an eleven-sided aperture at the center, and a ten-sided rotor turning within it. So closely are the two machined that there is always contact between them. Because the inner rotor has one less tooth than the outer one, it advances one notch with each complete revolution. Thus it pushes a small quantity of liquid trapped at the intake port over to the delivery port, where it is released. Constant action of successive teeth delivers a steady flow of the liquid being pumped.



DESIGN TROLLEY CARS FOR 60-MILE SPEED

BULLET-NOSED trolley cars of a new design, streamlined to reduce wind resistance, now travel at a mile-a-minute clip between Schenectady and Gloversville, N. Y. Built of aluminum, they seat forty-eight passengers. Magnetic brakes, designed by General Electric engineers, clamp down on the rails, supplementing the regular brakes and stopping the cars in three fourths of the distance that would be required without them.



CASH PRIZE WINNERS

Twenty-nine Who Proved Successful Showed Surprising Skill in Presenting Their Entries in Our

MARCH Heroes of Science CONTEST

HERE is the first group of winners in our Heroes of Science Picture Puzzle Cut-Out Contest — the twenty-nine skillful ones who struck gold in March!

We almost called them the "lucky" winners; but that would not have done them justice. Luck played no part whatever in their good fortune. It was by their skill and ingenuity that they won the prizes which, ranging from $500 to $10 in cash, make the handsome total of $1,000.

No special knowledge is required to win a prize in this fascinating contest; you need not be an expert in any field to compete. Those who won, did so because of their patience, neatness, and ambition. Every reader of POPULAR SCIENCE MONTHLY has an equal chance to win a prize.

If you have tried and failed, try again! The May contest does not close until May 31. The June contest, details of which will be found on the next two pages of this issue, runs until June 30.

Each month's competition is a distinct and separate contest in itself. Each month, until August inclusive, POPULAR SCIENCE MONTHLY will award $1,000 in cash, in prizes ranging from $500 to $10, to twenty-nine winners.

Everyone, whether he has won a prize in the monthly contests or not, is entitled to compete for the Grand Prizes, which will be awarded at the close of the contest. Details of the Grand Prize Contest also are given on pages 32 and 33. There still is plenty of time to compete! Seventy-one Grand Prizes, ranging from $2,000 to $10—a total of $4,000 in all—will be awarded to the winners in the Grand Prize Contest.

When these cash prizes are announced in the fall, someone, somewhere, will be thrilled to read his name at the top of the list and, beside it—"First Prize, $2,000." There is no reason why that "someone" should not be *you!*

FIRST PRIZE . . . $500

T. E. Torrison, ***Robbinsdale, Minn.***

SECOND PRIZE $100

Leonard F. Bollinger,
Kenosha, Wis.

THIRD PRIZE $50

Edmund Myers,
Wilmington, Del.

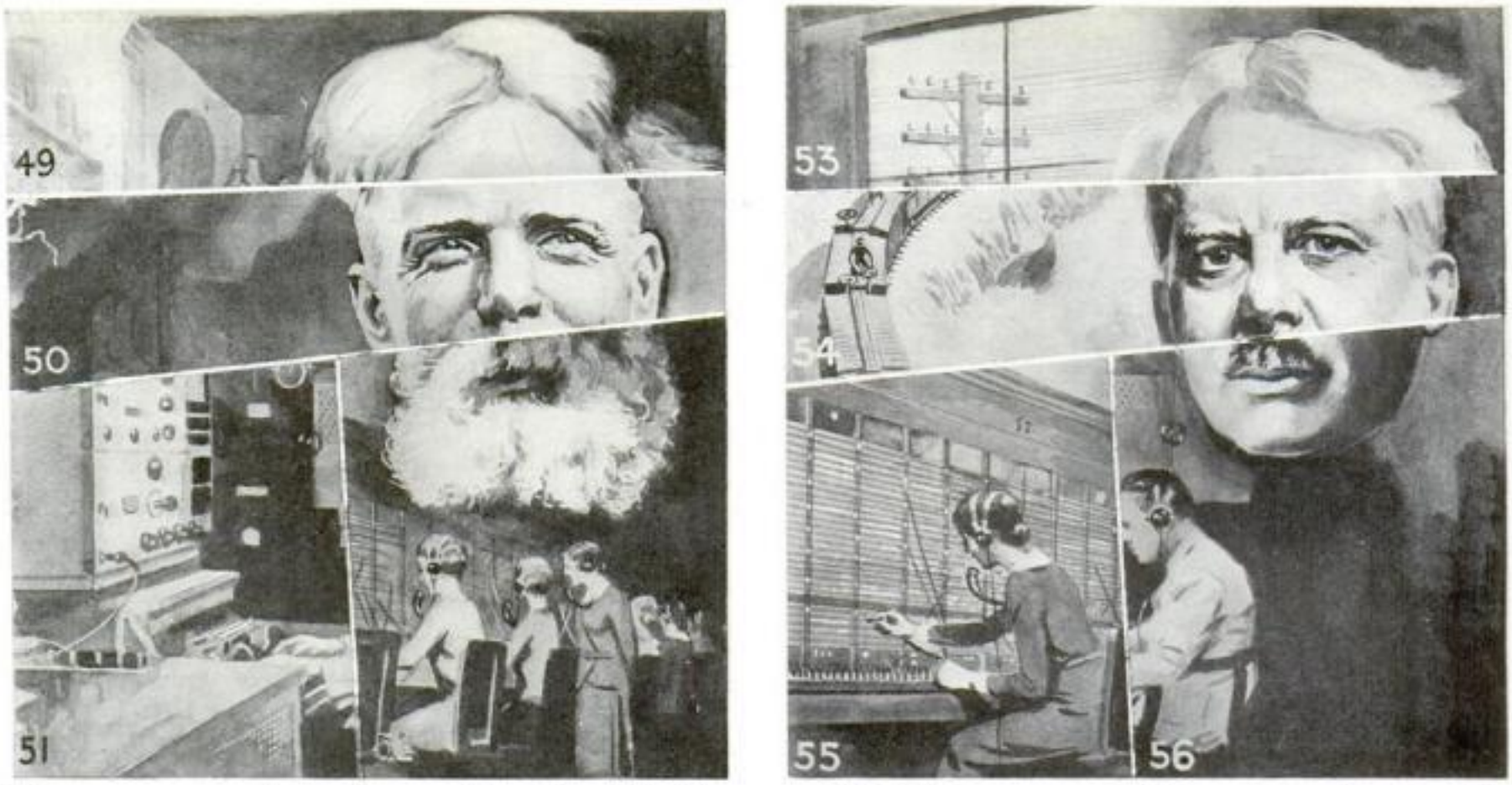
SIX $25 PRIZES

Fred Beaumont, *New Bedford, Mass.*
R. D. Blank, *N. Lewisburg, O.*
Ralph D. Clark, *Milwaukee, Wis.*
M. Coupland, *Dallas, Texas*
B. C. Murray, *Sioux City, Iowa*
Charles T. Sharpe, *Los Angeles, Calif.*

TWENTY $10 PRIZES

Anna Aloise, *Brooklyn, N. Y.*
V. E. Beck, *Waterloo, Neb.*
Marie Derro, *Milwaukee, Wis.*
G. A. Feil, *Richmond, Va.*
J. H. Field, *Fayettesville, Ark.*
Z. W. Gilbert, *Melrose, Wis.*
Robert Gillies, *Los Angeles, Calif.*
Norman E. Goldberg, *Racine, Wis.*
Bryan Hadley, *Clayton, Ind.*
Herman Honig, *Bronx, N. Y. C.*
John Mercer, *White Castle, La.*
Erna Polle, *E. Windsor Hill, Conn.*
Walter J. Quest, *Nashville, Tenn.*
D. W. Smallwood, *Wheeling, W. Va.*
E. P. Smith, *Chattanooga, Tenn.*
Glen H. Spurgeon, *Caldwell, Idaho*
Charles Stewart, *Huntington, W. Va.*
F. K. Van Almelo, *Nassau, N. Y.*
Lydia H. Ward, *El Paso, Texas*
A. W. Woehr, *Lakewood, N. J.*

¶ *YOU May Win a Prize by Entering Our Fascinating Picture Cutting Contest* . . . SEE TWO FOLLOWING PAGES



When you cut out these pictures along the white lines you will find it easy to put eight parts together to make

$10,000 *in* CASH

Here Are Two More Heroes of Science

ANNOUNCEMENT of the first prize winners in the Heroes of Science Picture Puzzle Cut-Out Contest will be found on page 31. To these twenty-nine clever and diligent persons, POPULAR SCIENCE MONTHLY is sending $1,000 in cash.

An evening's pleasant entertainment playing this new and fascinating scissors game brought them rewards of from $500 to $10 apiece. Their success should serve as an added incentive for others to enter the contest and participate in the winnings. It is not necessary to have entered previous contests to compete. Each month's competition is separate and distinct. Begin now and your name soon may be on the list of winners. Sharpen your scissors and try your skill.

Also, if you failed to win a prize this time, keep trying. Until the contest ends in the August issue, twenty-nine prizes, totaling $1,000, will be distributed each month. In addition, at the close of the contest, seventy-one Grand Prizes, totaling $4,000, will be awarded. These Grand Prizes will range from $2,000 to $10.

It is easy to play the scissors game and compete for a prize. Everybody, regardless of age, can take part. Here is how it is done: At the top of these pages you find four composite pictures. They represent Heroes of Science and Their Accomplishments. Each picture is divided into four parts. Each part belongs in a different picture. The pictures are so arranged that when you cut out the parts, eight of them will give you TWO COMPLETE PICTURES of Heroes of Science with eight parts left over.

There is no reason why you cannot win one of the cash prizes in this month's contest and one of the Grand Prizes at the end of the competition as well.

Assembling the cut-outs is not difficult. To aid you, we give clues to the identity of the heroes and the accomplishments for which they are famous. By using these hints, you will find that the work of solving the puzzles can be accomplished in a minimum of time.

The monthly prizes, which total $1,000, will be awarded to contestants who submit the two correct pictures, assemble and mount them in the neatest and most skillful manner, and state the name and accomplishment of each of the two Heroes of Science in twenty words or less.

After you have assembled the two complete pictures and sent them in to compete for the monthly prizes, be sure to KEEP THE EIGHT CUTTINGS THAT ARE LEFT OVER. They will give you TWELVE ADDITIONAL COMPLETE PICTURES of Heroes of Science, provided you have kept the left-overs from the beginning of the contest. These left-overs must be kept by the contestants throughout the six months of the contest and the additional TWELVE PICTURES must not be sent in until the close of the contest. At that time, the Grand Prizes will be awarded.

SUBMIT only TWO COMPLETE PICTURES, in which no left-over cuttings are used, in competing for the Monthly Prizes. The TWO COMPLETE PICTURES you send in this month must be assembled from the cuttings numbered from forty-nine to sixty-four inclusive.

To compete in this contest, you do not need to be a subscriber or regular reader of POPULAR SCIENCE MONTHLY. Nor is it necessary to buy the magazine. You may borrow a copy from a friend or see the current or three previous issues at the Public Library or at any office of POPULAR SCIENCE MONTHLY and trace or copy the pictures. You are permitted to get all the help you need from neighbors, friends, or relatives, and you may submit as many entries in each contest as you wish. Before you start work on this month's pictures, be sure to read the rules of the contest given on the opposite page.

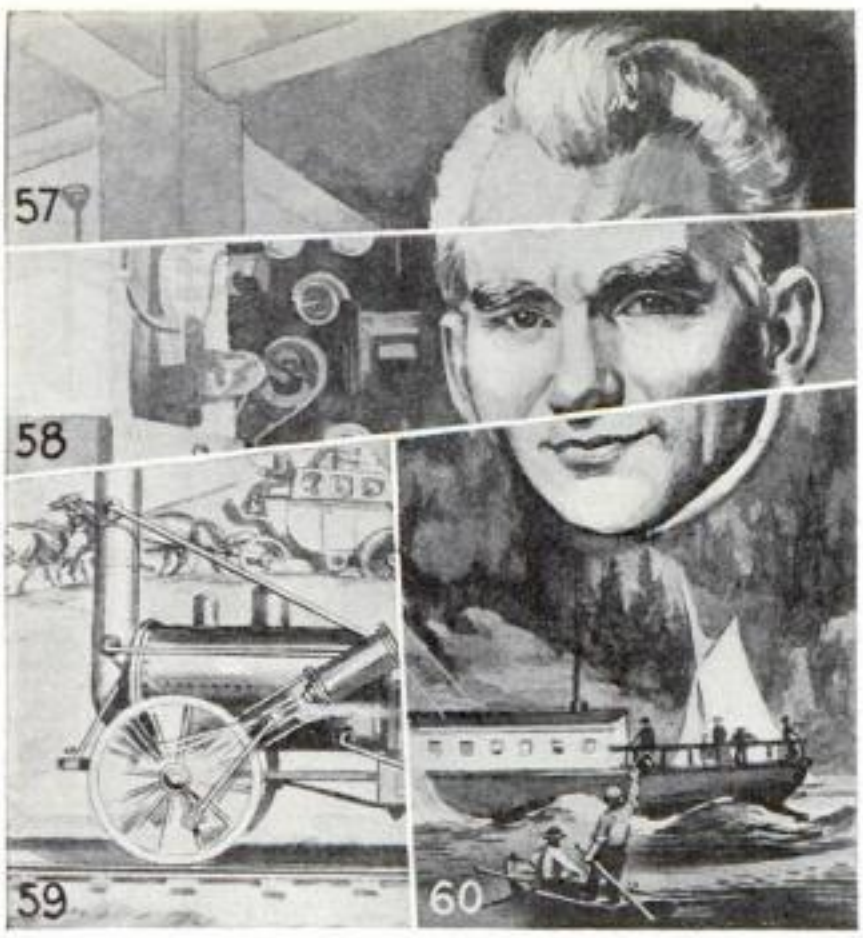
MONTHLY PRIZES

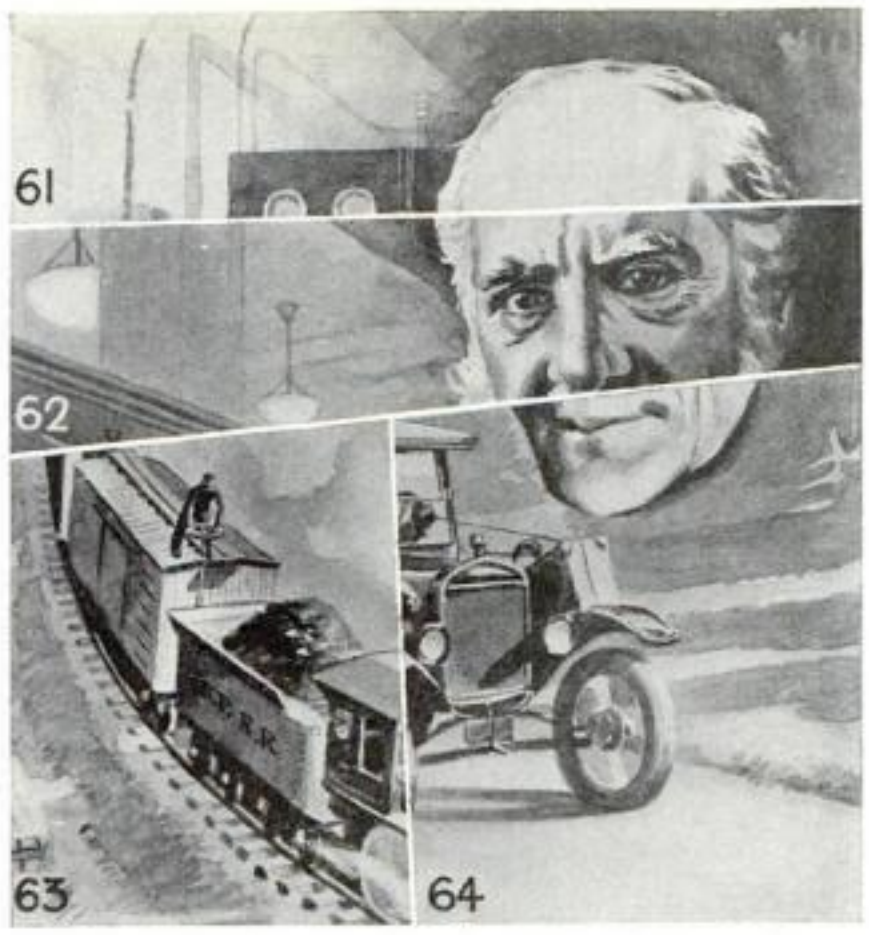
First Prize	$ 500
Second Prize	100
Third Prize	50
Six Prizes, $25 Each ..	150
Twenty prizes, $10 Each	200
Total	$1,000

GRAND PRIZES

First Prize	$2,000
Second Prize	500
Third Prize	200
Three Prizes, $100 Each	300
Five Prizes, $50 Each .	250
Ten Prizes, $25 Each ..	250
Fifty Prizes, $10 Each .	500
Total	$4,000

Turn to Page 31 for Names of Winners in the March Contest





two pictures. Carefully save the eight parts left over to use in making pictures for the Grand Prize Contest

PRIZES FOR SOLVING NEW AND EASY PICTURE PUZZLES

Bell, whose genius made possible the telephone of today

Stephenson, who led the world in developing locomotive

De Forest labored for many years to perfect radio tube

Westinghouse, inventor of air brake and industrial leader

Lindbergh, lone eagle of pioneer flight across ocean

Fulton, one of the first to use steam to propel a boat

The Men Whose Pictures Can Be Completed Are in Above Group

Rules of the Contest . . . Read Carefully

1. Each month, for six months, beginning with March, POPULAR SCIENCE MONTHLY is printing four composite pictures of Heroes of Science and Their Accomplishments. Each set of pictures, when cut apart and assembled correctly, will make two complete pictures with eight parts left over.

2. The pictures must be pasted together. The monthly prizes will be awarded to those contestants who assemble the pictures correctly and in the neatest and most skillful manner. Each of the two complete pictures must be accompanied by twenty words or less, identifying the Hero of Science and his accomplishment.

3. Answers to each monthly contest must be mailed or delivered to the offices of POPULAR SCIENCE MONTHLY not later than the last day of the month following the date of publication of the magazine in which the pictures appear. Thus, solutions of the puzzle in this month's issue must be mailed or delivered not later than June 30.

4. At the close of the six monthly contests, there will be a final contest for Grand Prizes. To compete for these, contestants must carefully save the cuttings left over from the monthly contests. These left-over cuttings, during the six months, will produce twelve additional complete pictures of Heroes of Science and Their Accomplishments, if assembled in the correct way. These additional pictures must not be submitted during the progress of the monthly contests, but at their close. Entries for the Grand Prize contest must be mailed or delivered not later than the last day of the month following the date of publication of the magazine in which the pictures for the last monthly contest appear. This will be the August issue, published July 2. Entries for the Grand Prize contest, therefore, must be mailed or delivered not later than August 31.

5. To receive consideration for the Grand Prizes, contestants must submit not less than twelve additional complete pictures.

6. Grand prizes will be awarded to those contestants who assemble the twelve additional pictures correctly and put them together in the neatest and most skillful manner. Each of the twelve pictures must be accompanied by twenty words or less, identifying the Hero of Science and his accomplishment.

7. In case of ties each tying contestant will be awarded the prize tied for. This rule will be observed in the monthly contests as well as in the Grand Prize contest.

8. All entries should be addressed to the Heroes of Science Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be acknowledged, and none will be returned. No letters of inquiry regarding points covered in the rules can be answered.

9. There is no entry fee. You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend and trace or copy the pictures, or you can examine a copy of the magazine at any office of POPULAR SCIENCE MONTHLY or at the public libraries free of charge.

10. Each contest is open to everybody, everywhere, except employes of POPULAR SCIENCE MONTHLY and the Popular Science Institute and their families. The officials of the Popular Science Institute will act as judges and their decision will be final.

STUDY OCEAN *to* Predict

Temperature and Acidity of Summer Seas Give Accurate Line on Amount of Winter Rainfall

TEMPERATURE near the surface of the ocean close to shore is recorded constantly on a thermometer that hangs at the end of a pier. Right, Dr. George F. McEwen drawing his ocean thermometer from insulated water bottle in which it is inclosed

SECRETS of the weather are being revealed by the waters of the Pacific Ocean. At the Scripps Institution of Oceanography, a department of the University of California, scientists are achieving remarkable success in long-range forecasting through study of the fluctuating temperature and chemical content of sea water.

Every morning at eight o'clock, the ocean's temperature is taken at La Jolla, Calif. From this information, and other data, the experts are able to predict, with amazing accuracy, the weather for many months in advance. The temperatures being recorded at present, for example, will be used to forecast next winter's weather on the Pacific Coast.

Recently, these forecasts have proved accurate seventy-five percent of the time. How remarkable this record is can be appreciated when it is remembered that the predictions of the U. S. Weather Bureau, made only twenty-four hours, instead of months, in advance, are correct only eighty percent of the time. The California scientists expect to be able to forecast periods of rainfall and drought five, ten, and even twenty years ahead through their study of the sea.

This success is the culmination of research begun sixteen years ago. The first long-range weather prediction on the basis of these studies was made in 1923 by Dr. George F. McEwen, famous oceanographer who is in charge of the work. Three or four years ago, several California public utility companies interested themselves in the study. Dr. A. F. Gorton, industrial physicist, joined Dr. McEwen in the work of tracing storms to their ocean sources and of predicting, on the basis of summer sea temperatures, the weather for the following winter.

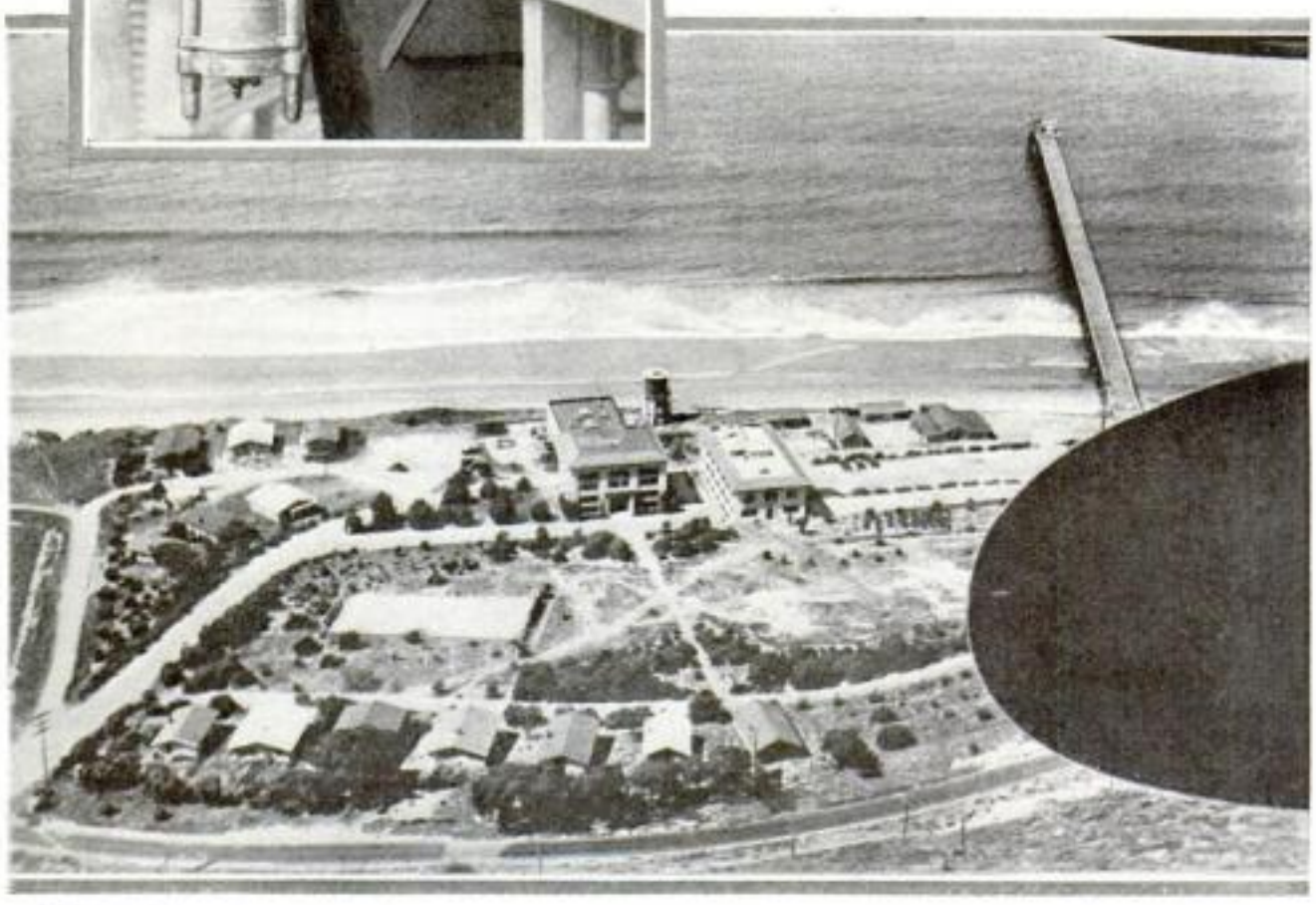
From their observations, the two men have come to the general conclusion that warm sea water in summer indicates a dry winter and cold water a wet winter.

On the long experimental pier that juts into the Pacific near La Jolla, I recently watched the scientists at work. Dr. Gorton lowered the steel-incased thermometer over the side of the pier. Then he hauled it up quickly to read the temperature before the tiny amount of water remaining in the cup around the mercury could begin to cool. This cupful of water serves as a reservoir to give more accurate readings than would be possible were the thermometer not so protected. The water is always taken from a uniform depth near the surface.

There are other things, too, that enter into their computations. I was shown a tide gage swinging up and down on a barnacle-covered pile on the La Jolla pier. Day and night, it writes its story of the restless sea on a paper-covered cylinder. Also, each day, a small sample of the Pacific's green water is analyzed to learn whether there has been an increase or decrease in the chemicals it contains. This record of shifting chemical content is highly important. It indicates when the ocean is spouting water from its depths to the surface.

These gigantic undersea fountains bring colder and more acid water from the ocean's floor. They are believed to play an important part in producing wetter winters, with heavier snows in the mountains and increased danger of floods in the spring.

"While changes in the weather are periodic," Dr. McEwen said as I walked with the two sea scientists back to shore, "seasonal conditions from one year to another are not precisely the same as those of the preceding or following year. This deviation from the average is what upsets the apple carts of power companies, water companies, and agricultural enterprises. We know the physical causes of the succession of seasons. Now we are



SCRIPPS Institution of Oceanography as seen from the air. It is here that elaborate study of sea water and temperature is being made in an effort to predict next year's rainfall

Weather Months *in* Advance

By ANDREW R. BOONE

seeking the causes of deviation from the average in any one year."

Since 1854, when a great storm on the Black Sea during the Crimean War took such toll of ships and lives that the French started the first national weather service, methods of daily forecasting have improved rapidly. However, they are of little help in estimating seasonal rainfall, for the season is made up of a succession of storms, any one of which takes a week or so to cross a continent. Since conditions of pressure, temperature, and wind change during that time, today's weather map has little bearing on next week's weather.

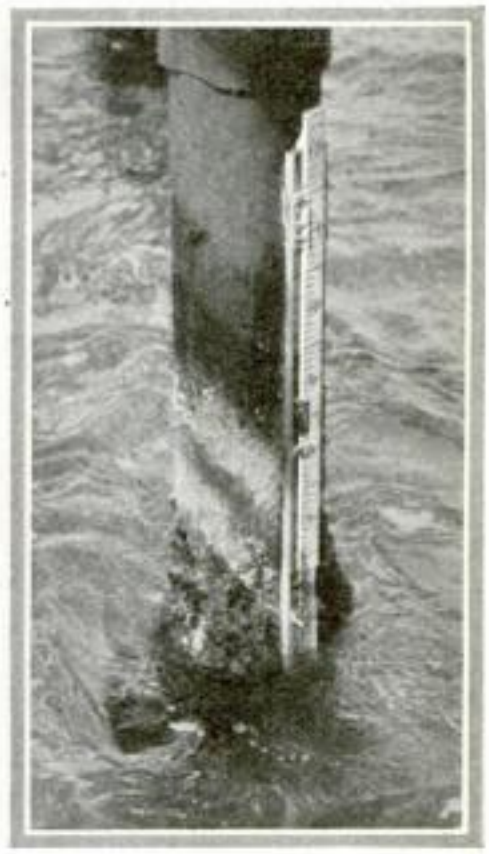
"Since we cannot hope to predict at the beginning of each season the occurrence of individual storms and their water production," Dr. McEwen told me, "we are driven to inquire whether there may not be a *trend* in rainfall and temperature so we can classify seasons as wet or dry, cold or mild."

Assuming that there is such a trend, the scientists have worked on the theory that it can be forecast by using as a basis an element that bears a definite relation to rainfall, the sea's temperature changes.

"If we can establish the length of the cycles accurately," Dr. Gorton added, "we can forecast the trend of rainfall over five, ten, or twenty years. The great drought of 1930-31, for example, was merely the climax of fifteen years of deficient precipitation in California."

In many lands scientists now are studying weather that comes out of the sea. In the Netherlands, East Indies, Japan, Australia, and South Africa, the relation between sea water temperature and rainfall is being investigated. The Long Range

SOLAR RADIATION is recorded on top of the Scripps Institution, the thermal element being housed under an oval glass, left, and connected by wires with the recording device, right, in the institution's laboratory. Dr. Gorton is reading the day's chart of radiation



TIDE GAGE, right, seen in position below the pier at Scripps Institution of Oceanography. Dr. McEwen, left, is reading the record made by the tide gage

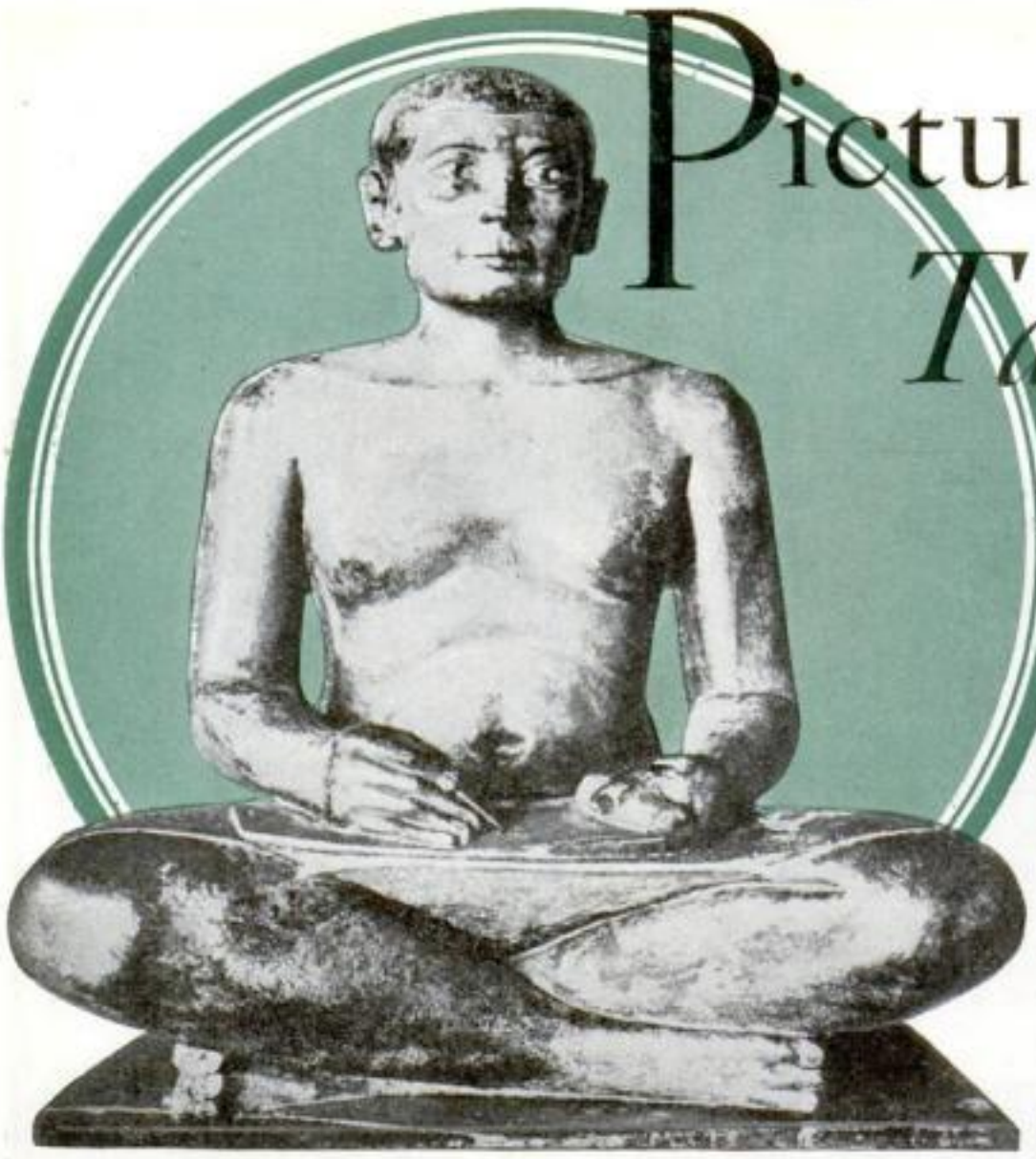
CHEMICAL CONTENT of surface sea water enters into the scientific study of the sea as a long-distance prophet of the drought or flood of the following season

Forecasting Institute, at Frankfort, Germany, a governmental agency; Sir Gilbert Walker, in India; and several Australian scientists are using systems of research fundamentally the same as that developed by Dr. McEwen and Dr. Gorton.

Study of weather records shows that the temperature, atmospheric pressure, and rainfall in one part of the globe have a definite bearing on rainfall elsewhere during the following season. The British, for instance, forecast the summer monsoon rains in India by studying the pressures during the previous quarter in South America and Australia, the temperatures in Samoa, and measuring the depth of the snow on the hills north of the Indian peninsula. Thus they learn how much water the warm winds will lift from the sea and the land to deposit on the Indian highlands.

Several years ago, the Indian Meteorological Service began to forecast the monsoon rainfall of India. These deluges represent weather at its worst. Everyone who has seen heat waves rising from a hot stove top can understand what happens. North of India, Tibet is the world's largest natural stove. It is a great block of land, two miles above the sea, and bare to the summer sun. Heat waves rise from Tibet, and, to take the place of this rising lighter air, *(Continued on page 118)*

Pictures *on* Rocks *Taught MAN*



Limestone statue of an Egyptian scribe writing his hieroglyphics on papyrus. The figure, now in the Louvre, was carved in ancient Egypt

Hieroglyphics on this Egyptian stone tell of sunworship ceremony of 4,000 years ago

Courtesy, Metropolitan Museum of Art

Egyptian scribes, standing and kneeling as they work, with palette under the arm, painting characters on tablets with reeds

ONE thousand million years ago, there appeared a microscopic life germ in the mud that covered the earth. This tiny speck of living jelly, biologists say, was Man's first ancestor. In the early chapters of our series, Dr. William K. Gregory, famous scientist of the American Museum of Natural History, traced Man's mysterious development through various life forms up to the human stage. Then, Dr. Herbert Ruckes, of the College of the City of New York, explained how Man, through the mechanism of inheritance, passes his characteristics on to his offspring. The development of Man's mind and emotions next was sketched by Dr. A. T. Poffenberger, of Columbia University. Continuing the story, Dr. Clark Wissler, distinguished anthropologist of the American Museum of Natural History and Yale University, drew a vivid picture of the Stone Age. Last month, he told Michel Mok, staff writer, how men became farmers, brewers, and bakers, and learned to work metals. In this talk, Dr. Wissler describes the origin and development of the art of writing, without which we could know little about the past.

MR. MOK: When and how, Dr. Wissler, did people begin to express their thoughts in readable signs? Who invented the alphabet, and when was it first used?

DR. WISSLER: You picked a very fortunate time to get an answer to your second question. Only a few months ago, an American archeologist made a wonderful discovery. From a heap of ancient rubbish amid the ruins of Gezer, the royal city of the Canaanites in Palestine, he extracted a scientific jewel of the first water. It was a two-inch scrap of pottery jar bearing part of an inscription. This turned out to be the oldest bit of alphabetic writing in existence.

MR. MOK: How do you know that?

DR. WISSLER: Studied by experts, the priceless piece of clay was shown to date from 2,000 B.C., and the script to be the crude, earliest known forerunner of our A B C's. In this way, it was definitely established that the alphabet was used nearly 4,000 years ago by the Canaanites, who held the Promised Land before the Children of Israel claimed it. They probably originated the system.

MR. MOK: I was told the Phoenicians invented the alphabet.

DR. WISSLER: That is what we all believed at one time, but now we know better. However, I will tell you more about it after a while. Let us begin at the beginning. You must understand that the alphabet, ancient though it is, represents the last stage in the development of writing. People wrote thousands of years before it had been thought of. And that brings me back to your first question: The origin of the methods which you will use to put this interview on paper for POPULAR SCIENCE MONTHLY really goes back to the Stone Age; that is, about 25,000 years.

MR. MOK: You mean to say that people could write in those early days?

DR. WISSLER: No, but they could draw, and that was the beginning of writing. When you were a small child, you drew awkward pictures of men, houses, trees, animals. Mankind as a whole passed through the same experience in the childhood of the race. Many centuries before people learned to write, primitive man delighted in making images of the objects and animals around him. A month or two ago, I told you about the Stone Age Men of the reindeer period in Central France, who carved figures of animals on bone and

4,000 Years Ago *his* A B C's

At left, the famous Rosetta Stone that unlocked all the mysteries of Egypt's hieroglyphics. Above, the triple inscribed stone which is the key to the Babylonian writings and tells of the victories gained by Darius of Persia

This example of phonetic writing is from the Aztec and shows how the natives of Mexico wrote the words "pater noster" by using their signs for the words flag, stone, and prickly pear. It is assumed that this is exactly the way in which sound writing first developed

Australian bushmen of the present still draw strange figures in sand which convey messages to their fellow tribesmen though the symbols are mysterious to the stranger

horn, or painted them on the walls of their caves (P. S. M., Apr. '32, p. 118). From carving or drawing such pictures to recording events or sending messages by means of images was an easy and logical step. That is how the oldest kind of writing—picture writing—came into being. To this day, millions of people use certain forms of picture writing, and even we have survivals of it in our written language.

MR. MOK: I did not know that. What are they?

DR. WISSLER: We will come to them presently. For the moment, let us stick to the primitives. They began with realistic pictures, or as realistic as they could make them. For instance, in recording a hunt or a battle, with so many slain and so many captured, they told their story in crude but complete pictures of animals or men, with or without the heads. This slow and cumbersome method prevailed until an extremely clever fellow, most likely an Egyptian living about 5,000 B.C., invented the world's first system of shorthand.

MR. MOK: Who would have thought that stenography was 7,000 years old?

DR. WISSLER: You are right in calling it that, for stenography literally means the art of making little pictures. What our smart Egyptian friend devised was a system of picture shorthand. He realized that it was not necessary to draw a complete picture to convey an idea. Just as you, when you were a small boy, expressed the idea "man" by a vertical line, topped by a little circle for the head and provided with four shorter lines to represent the arms and legs, so he simplified the old pictures, drawing only a few lines to indicate a person, animal, or object. This notion gave rise to so-called conventionalized pictures; that is to say, drawings which, though incomplete or perhaps distorted, yet readily suggest the object, and the style of which becomes standardized.

MR. MOK: Will you please give an example?

DR. WISSLER: Certainly. Suppose the ancient Egyptian stenographer's real profession was that of warrior. In a message to his king, he wished to report that he had taken the spear from a dangerous enemy. Instead of drawing an elaborate picture of himself, carrying two spears, and of the beaten enemy, he merely made a quick sketch of a hand holding a spear. The king understood. Pretty soon, other Egyptian soldiers adopted the sign. Thus a hand grasping a spear became a conventionalized picture; the Egyptians tacitly agreed on using it as a symbol for the idea of disarming an enemy. Mind you, I do not mean that this particular picture had this precise meaning in ancient Egyptian; I merely cite it as an instance of how picture writing developed.

MR. MOK: What was the next step?

DR. WISSLER: A very important one. It was taken when someone, probably

AMERICAN INDIANS WROTE IN PICTURES

American Indians also had their picture writing in which the image had an indirect meaning. Above, the bird stands for the name of the leader of the five-canoe expedition and the turtle means a landing. The dots stand for three days. The figures on the rock at the left tell the story of a successful hunting trip

also a brilliant Egyptian, conceived the idea of selecting certain of these abbreviated pictures of objects and actions, to represent *words*. For convenience, take the same example—the picture of the hand with the spear. From a symbol expressing the idea "disarming an enemy," it now became *the written equivalent of the spoken word "disarm,"* or "victory," or whatever it was decided it should represent, and henceforth an Egyptian, encountering it in a record or a message, simply *read* it as such. You can readily see how a written language, which an entire people may read just as we read English, can be built up in this way. A picture of the sun, for instance, may become the drawn (or written) equivalent of the spoken word "day"; that of an owl, of the word "night"; that of a rising sun, of the word "morning"; that of an owl preceded or followed by a black square, of the words "dark night"; that of footprints or tracks of man or beast, of the word "walk" or "travel"; a wavy line, of the word "water," and so on.

MR. MOK: You mean, then, that they wrote and read a number of predetermined pictures, each of which stood for a definite word?

DR. WISSLER: Precisely. An excellent example of this simple form of abbreviated picture writing is the record of an expedition across Lake Superior carved by a hunting tribe of Indians on a rock found near the lake. There were fifty-one men in the party, and they are represented by as many small vertical lines sticking up from crude sketches of five canoes. One of the commanders, whose name was Kingfisher, is depicted by a bird of that species. The landing is "described" by a picture of a land-tortoise; and the fact that the expedition took three days is depicted by three dots (for suns) under a triple half-circle indicating the sky. Such primitive picture records are called pictographs.

MR. MOK: A clever system!

DR. WISSLER: Yes, but still incomplete. One big problem remained to be solved.

MR. MOK: What was that?

DR. WISSLER: As you see, they now had symbols for the names of persons, animals, objects, and natural phenomena, but none for abstract ideas. This difficulty they overcame by making pictures of objects universally associated with the ideas, such as teardrops for the word "sorrow"; blossoms for the word "spring"; a sword or a spear for the word "war," and so forth. With symbols for abstract ideas decided upon, the written language was complete. This kind of picture shorthand is known as hieroglyphic writing. The Egyptians, who were the first to perfect it, had a full fledged system of hieroglyphics before 4,000 B.C.

MR. MOK: From what you have told me, they should be easy to read.

DR. WISSLER: Easy? Far from it! The trouble is that, as time went on, the pictures became so distorted and diagrammatic that it is extremely difficult, and often impossible, to recognize the original images in them. The only way scientists can trace the pictorial origin of hieroglyphics is by comparing them with corresponding symbols in earlier and simpler stages of their development. To make matters even more difficult, the Egyptians had two kinds of picture writing—the hieratic, or sacred, used exclusively by the priests; and the demotic, or popular, used by the educated classes of the people. As a matter of fact, nobody could decipher hieroglyphics until 133 years ago, when an officer in Napoleon's army discovered the key to them. If it had not been for that, we might not even have known that the strange figures on ancient Egyptian monuments and tomb walls were a written language.

MR. MOK: What was this key?

DR. WISSLER: The famous Rosetta stone, so called because it was unearthed near Rosetta, a few miles from Alexandria, in Egypt. It is now in the British Museum, in London. The lucky finder was a young French artillery lieutenant with a taste for archeology, named Boussard, who discovered it in 1799, during Napoleon's Egyptian campaign. It is a slab of slate, containing inscriptions in three kinds of writing—hieratic and demotic Egyptian and Greek. The Greek inscription, of course, could be read. But the meaning of the two others remained a mystery until Jean François Champollion, a noted French scholar of the time, working on the assumption that the Greek was a translation of the Egyptian, deciphered them.

FOUR ALPHABETS COMPARED

Though nearly 4,000 years have passed since the alphabet was invented, it remains today, after passing through the hands of many different races, very much as it was when first put in use. The similarity among alphabets is suggested above

MR. MOK: A while ago, you said that millions still use picture writing. Did you mean that the modern Egyptians write hieroglyphics?

DR. WISSLER: Oh, no; they don't. I meant the Chinese and others who have adapted their writing methods, such as the Japanese and the Koreans. Their writing to this day is based on pictures.

MR. MOK: One would not think so from looking at the scrawls on a Chinese laundry list. They never would win a prize in an art exhibition.

DR. WISSLER: I agree with you, but those ungainly scrawls, nevertheless, grew out of delicate little pictures which ancient Chinese scholars designed thousands of years ago. They are not called hieroglyphics, but ideographs, or idea pictures, because most of them depict thoughts rather than tangible objects.

MR. MOK: You told me that we have some survivals of picture writing in our written language. Will you please explain that?

DR. WISSLER: Yes. What I meant was that we use a number of signs that are meaningless in themselves, but which we all agree stand for definite things. Take, for example, the question mark (?). It is not a word; it does not spell anything; yet everybody can read it and knows what it means. It simply is a picture-shorthand symbol, just as much as any Egyptian hieroglyphic. The exclamation point (!), the dollar sign ($), the English pound sterling sign (£), the pound-weight sign (lb.), and the plus (+) and minus (—) signs, all are symbols of this sort.

MR. MOK: How did those signs get their meaning?

DR. WISSLER: As in the case of Egyptian or *(Continued on page 112)*

SCIENTIFICKS

...OUR ARTIST VIEWS THE STRANGE AND UNUSUAL FACTS DISCLOSED BY LEADING AUTHORITIES IN THE LAST MONTH

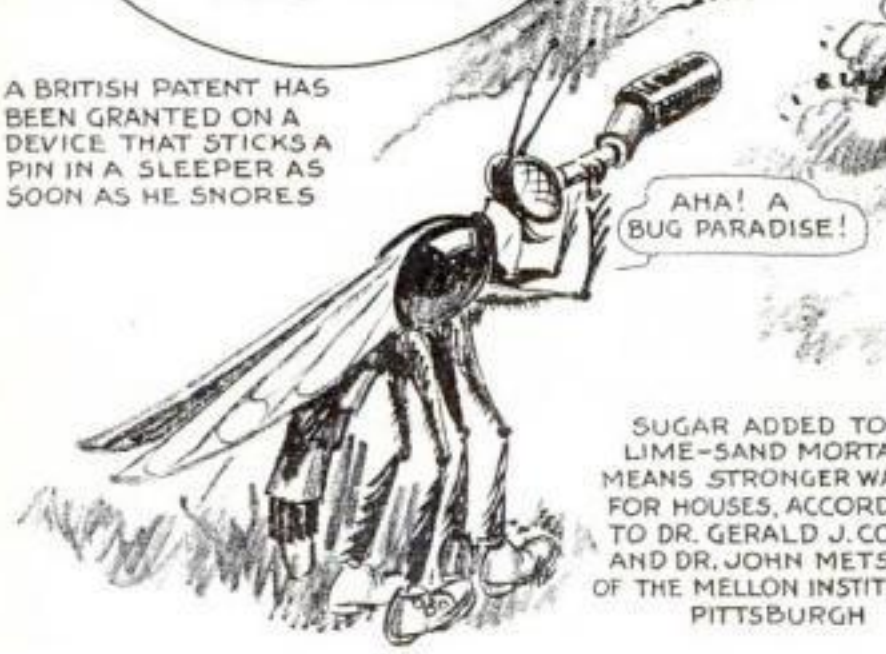
THE USE OF ROUGE PROMOTES HEALTH, STATES H. STANLEY REDGROVE, ENGLISH HYGIENIST

CAVEMEN WERE HENPECKED TOO SAYS THE REV. JOHN M. COOPER, ETHNOLOGIST, OF THE CATHOLIC UNIVERSITY, WASHINGTON, D.C.

A MALE MONKEY PLUCKS HIS GIRL FRIEND'S EYE-BROWS, ANNOUNCES DR. O.L. TINKLEPAUGH, OF YALE UNIVERSITY

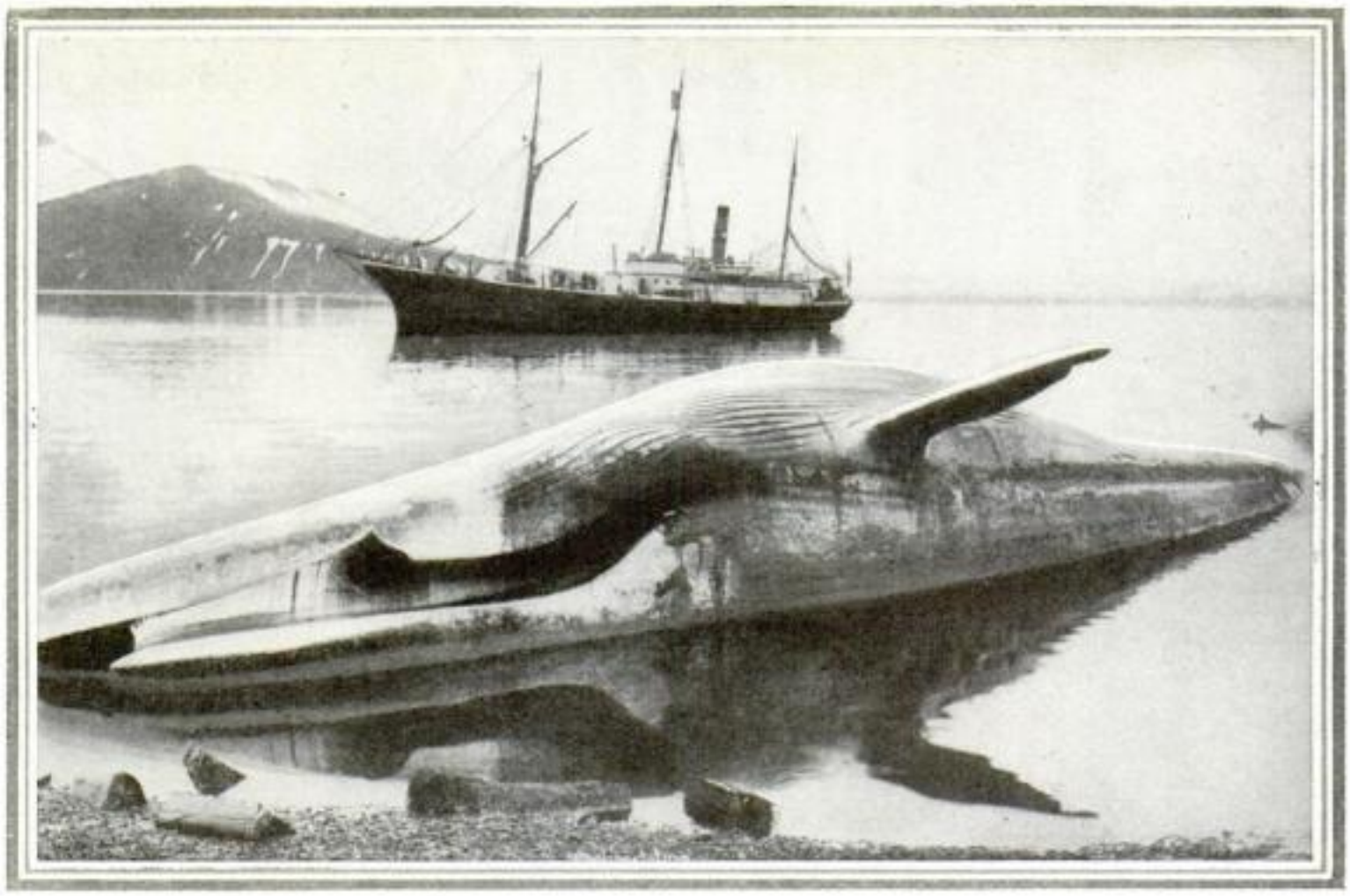
BATH TOWELS USED IN 2000 B.C. HAVE BEEN FOUND IN AN EGYPTIAN TOMB BY AN EXPEDITION OF THE METROPOLITAN MUSEUM OF ART

A BRITISH PATENT HAS BEEN GRANTED ON A DEVICE THAT STICKS A PIN IN A SLEEPER AS SOON AS HE SNORES



SUGAR ADDED TO LIME-SAND MORTAR MEANS STRONGER WALLS FOR HOUSES, ACCORDING TO DR. GERALD J. COX AND DR. JOHN METSCHL OF THE MELLON INSTITUTE, PITTSBURGH

A YELLOWSTONE PARK MOOSE LISTENED WITH APPARENT PLEASURE TO RADIO MUSIC, BUT RAN AWAY WHEN THE ANNOUNCER BEGAN TO SPEAK



GIANTS OF SEA STRANDED ON SHORE

At Spitsbergen, the leading whaling station in the world today. Photo shows carcass of whale that has been towed to shore to be dismembered for oil and fertilizer

Hunt Whales *with* Bombs

CHEMISTS TEST WHALE OIL

Whale oil is tested and carefully checked in modern whaling industry. Picture in oval shows the testing room of a whaling station in New York harbor which is equipped with every modern device for handling the product taken from whales

Left, a striking photo of a shot fired from the harpoon deck of New Zealand whaler

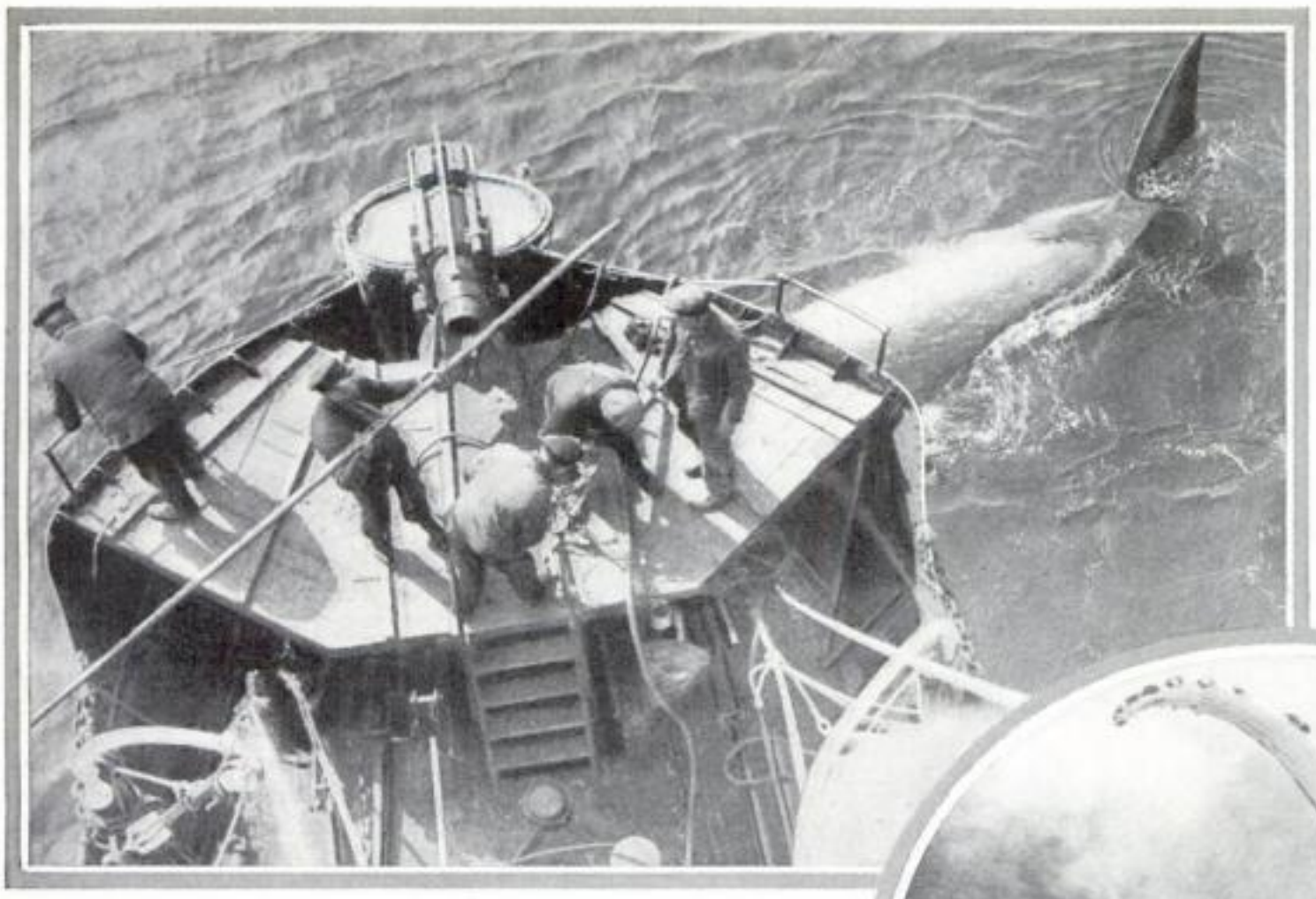
NEW whales for old! Modern equipment not only has revolutionized the whaling industry, but enables whalers to capture species of the ocean giant against which the old methods were ineffective.

The Svend Foyn harpoon cannon, firing a heavy projectile with line and explosive bomb attached, has replaced the hand-thrown harpoon, and great factory ships with large, steam-powered hunting boats take the place of the sailing vessels that plied the Arctic waters in the nineteenth century.

How this and other up-to-date equipment has placed entirely different species of whales within the present-day whalers' grasp was explained recently by Dr. Charles Haskins Townsend, director of the New York Aquarium. While the catch of the old-time whaler was limited to the slower moving types, such as the sperm and the right whale, today's boats and weapons permit the capture of the swifter blue whale, finback, humpback, sei whale, and others too speedy for the open boats and hand harpoons of a bygone day.

The floating factories, equipped with radio, can run down six or eight big blue whales in one day, and more than twice as many of the smaller kinds. A large blue whale may yield as much as seventy-five barrels of oil; humpbacks and fin whales about half that quantity. Whale oil is worth approximately $26 a barrel.

Several of the factory steamers in use in northern waters exceed 12,000 tons in size. The *Kosmos*, a new vessel that began operations in the Ross Section of the Antarctic recently, is a 22,000-ton ship. It is accompanied by seven steam hunting



PRIZE IS MADE FAST TO SHIP

This remarkable photograph gives a good idea of the activity on the harpoon deck of a whaler after a shot has been fired successfully. The mechanism is capable of firing a five-foot harpoon that weighs more than 100 pounds. Below, a whale being dismembered

and Motors

boats, and carries an airplane. It has two working decks; one for oil production and the other for the preparation of fertilizer from the whales' carcasses. There also is a plant for the canning of whale meat.

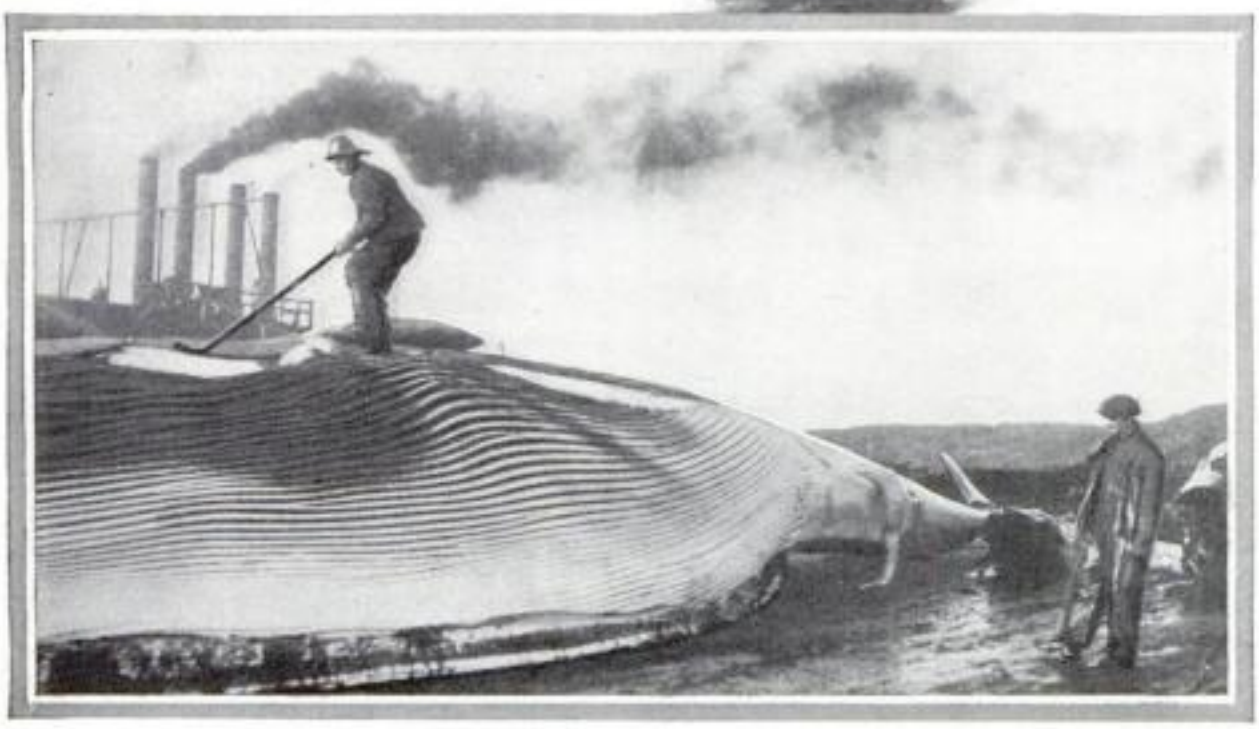
Whaling today is largely a Norwegian industry, and Spitsbergen still is the largest whaling station in the world.

A single whale may be worth from $500 to $10,000. The bulk of the oil is used in the manufacture of soap, for oiling wools for combing, in leather making, and lubricating machinery. Whalebone is used largely in making mechanical brushes.

To protect the whale from extinction, the Norwegian parliament recently passed a law forbidding Norwegian whalers to kill certain species, particularly the right whale, and all whale cows with calves.

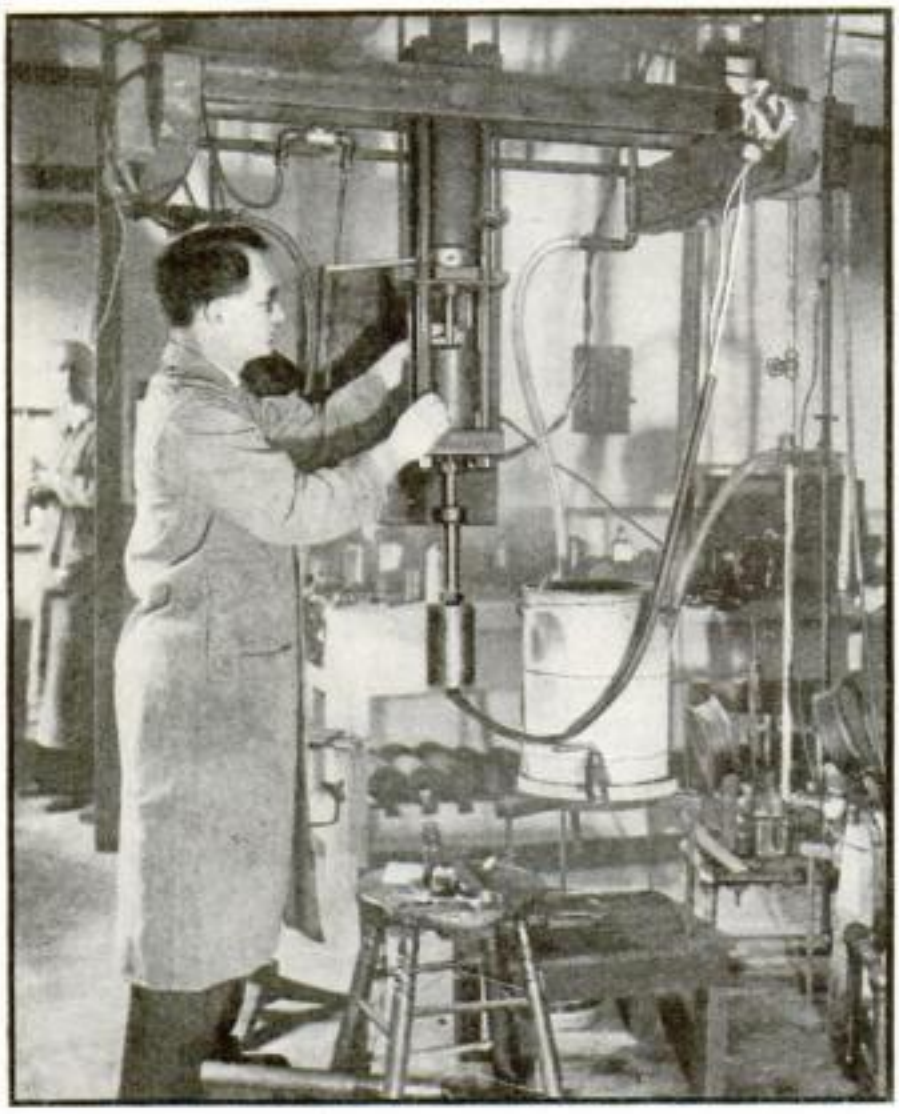
Left, carcass of a whale, blown up so it will float and marked with a flag to show location

The gigantic jawbone of a whale is caught by a crane and hoisted to the deck where it will be broken up



Floated to shore, experts attack the whale's carcass and strip away the blubber as shown in photo at the left

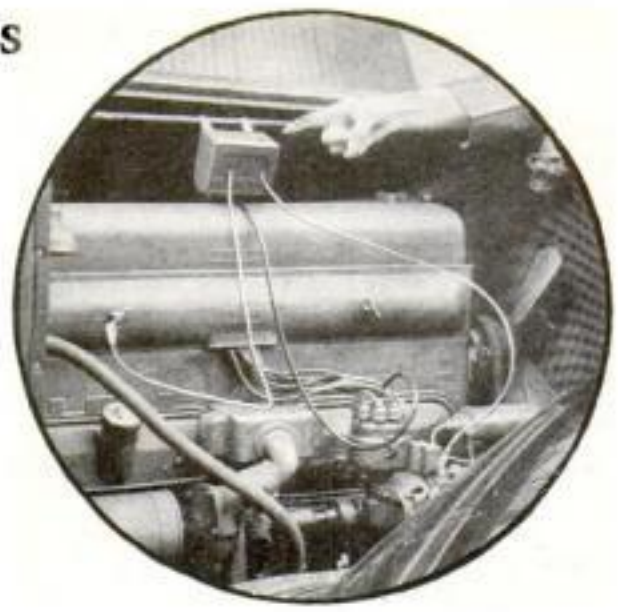
Big Pressure Machine to Find Earth's Secrets



High pressure apparatus to be used in studying earth's center

WHAT the center of the earth is like may soon be revealed by duplicating in miniature the tremendous heat and pressure of the earth's core. Using apparatus developed by Dr. P. W. Bridgman; noted physicist, Harvard University is planning a study to last for five years.

With Dr. Bridgman's powerful machine water has been squeezed into five different solid forms and air compressed into a substance with the solidity of water. The combination of terrific heat and pressures is expected to explain the cause of earthquakes and reproduce the condition of substances thousands of miles below the surface of the earth.



NEW IGNITION COIL STARTS LOCKED CAR

YOU can now lose your switch key and yet get the car going in less than a minute if you have in your tool kit a new emergency ignition coil fitted with a continuously operating vibrator. The high tension lead is connected to the center terminal, replacing the wire from the car's ignition coil. Current is obtained by clipping another wire to the generator terminal and a third wire is grounded. The high tension current is fed to the proper plug by the rotating distributor arm.

POCKET MAGNIFIER FOR SMALL CAMERA PRINTS

INCREASING popularity of cameras that take miniature pictures has lead to the introduction of a compact magnifier that makes inspection of small prints easy, and lends much to their appearance by making them appear almost stereoscopic. A magnifying lens of four-inch focus is hinged to the end of a shallow metal box having a sliding lid. Prints to be viewed through the lens are held by a slot in the end of the lid. The box will hold four dozen prints, one and three-quarters by two and one-quarter inch. When not in use the lens folds into the box.

Pictures taken with tiny camera can be seen clearly with this pocket magnifier that will hold forty-eight prints

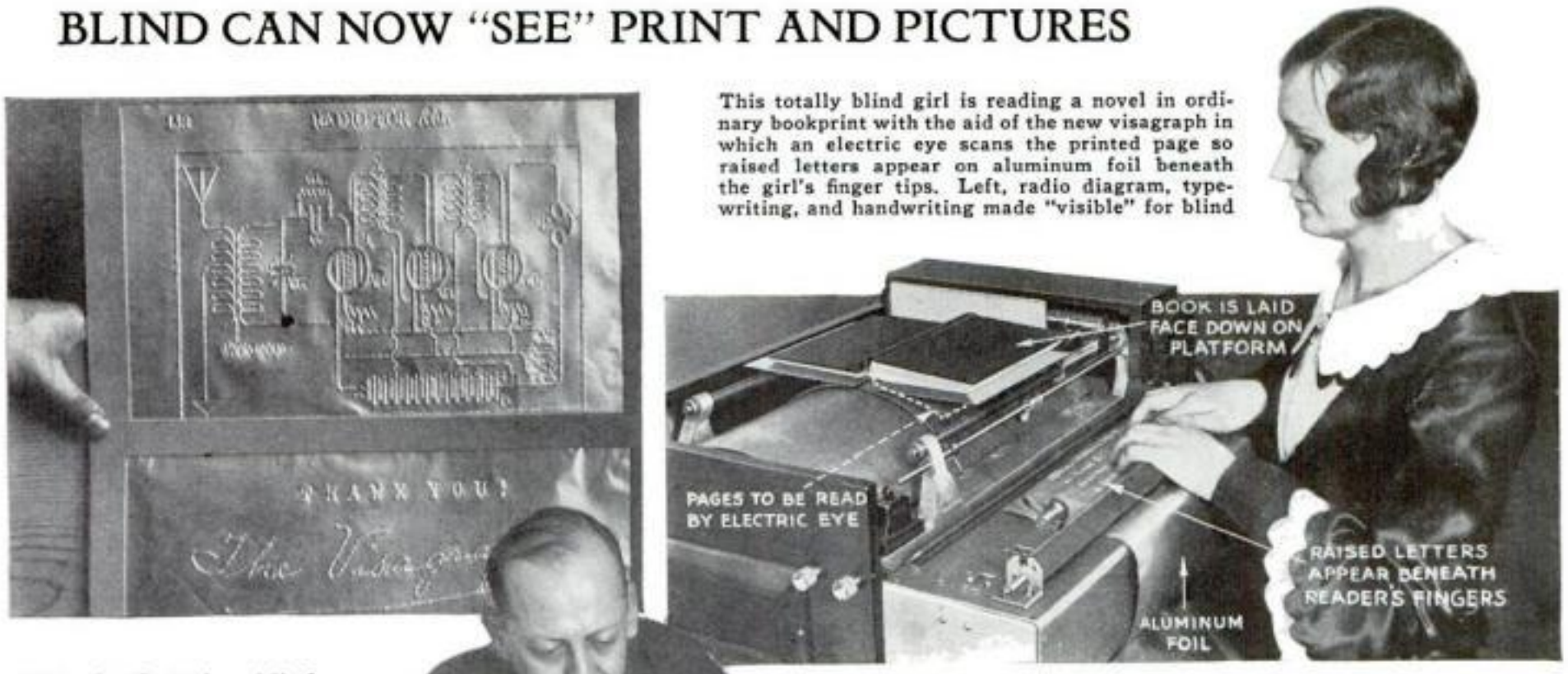
LANTERN'S SPOTLIGHT IS SPREAD BY LEVER

WHAT is declared to be a new focusing principle is incorporated in an electric lantern recently placed upon the market. A touch of a lever on its base shifts forward a small auxiliary reflector that provides a broad, diffused floodlight. When the small reflector recedes, a large one comes into play giving a spotlight beam.

ITALY HAS NEW 88-PASSENGER BUS

A THREE-STORY bus that carries eighty-eight passengers, more than three times the number accommodated by a standard Pullman car, has just been introduced in Italy for service between Rome and Tivoli. By using light duralumin, the metal widely employed in airplane construction, in the design of the huge machine, the makers have kept down the weight. Besides carrying its immense load of passengers, the bus will transport an additional 440 pounds of baggage. It is thirty-nine feet long and ten feet wide and has a speed of twenty-eight miles an hour. It runs on six wheels. Special compartments are provided for the storing of baggage, for dogs, and for smokers.

BLIND CAN NOW "SEE" PRINT AND PICTURES



This totally blind girl is reading a novel in ordinary bookprint with the aid of the new visagraph in which an electric eye scans the printed page so raised letters appear on aluminum foil beneath the girl's finger tips. Left, radio diagram, typewriting, and handwriting made "visible" for blind

This form of the visagraph reproduces a map from a newspaper so that it can be "read" by a blind man

For the first time blind persons may actually "see" pictures and read newsprint and typewritten letters, through the medium of their finger tips, with a device that was demonstrated the other day in New York City. Termed the "automatic visagraph" by its inventor, Robert E. Naumburg, it scans a printed page with an electric eye. Black-and-white outlines of letters and drawings are transformed at high speed into raised and magnified lines, punched by a vibrating needlelike point upon moving sheets of aluminum foil.

In this device the inventor has radically improved an earlier model demonstrated a year ago, which he called his "printing visagraph" (P.S.M., July '31, p. 40). That machine, resembling an office desk in size and appearance, transformed ordinary bookprint into embossed letters that could be read with the fingers. It was hailed as an amazing development, though the user had to perform rather complicated adjustments in inserting the book, and though smaller type than bookprint was beyond its reach. These handicaps have now been removed.

So far improved is the new "automatic visagraph" by a modified scanning system that it will reproduce the type of newspapers, magazines, and virtually anything in print. Even such things as radio diagrams and maps, hitherto inaccessible to a blind person because not even an attendant could read them to him, are now made "visible."

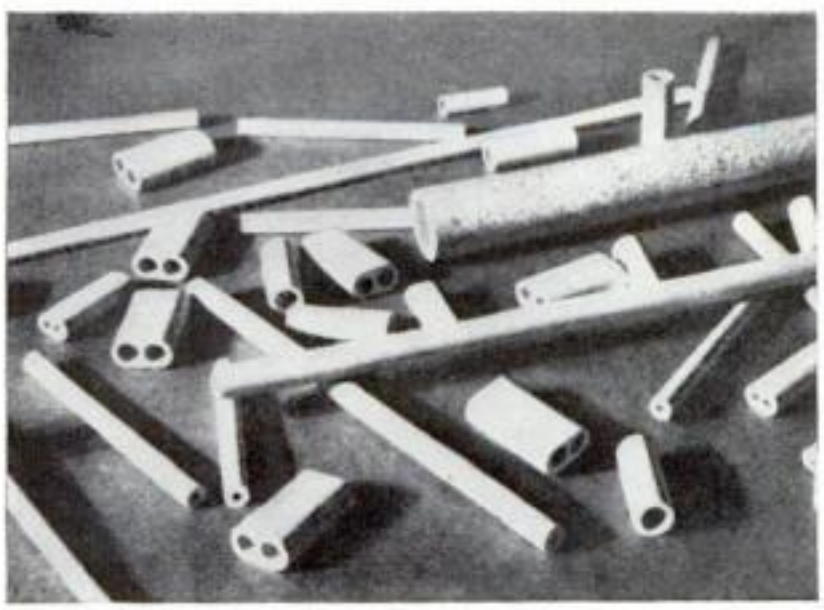
To read a book with the latest model, two of the pages are thrust through a slot, with no effort to straighten the book or align it. The volume is pushed automatically across a transverse slit, beneath which a fast-moving electric eye scans the printed line.

NEW SUBSTANCE RESISTS HEAT SHOCKS

Since substances expand with heat and contract with cold, builders of instruments and bridges, who would prefer their work to be unchanging in size, recently hailed with delight the discovery of a new material less susceptible to the caprices of temperature than those now in use.

This new substance is a ceramic, and can be manufactured in an almost unlimited variety of forms. Its expansion within everyday ranges of temperature is only half that of invar, a metal alloy from which surveyor's tapes are made and the least expansive substance now in use.

Far from a useless curiosity is the new ceramic, which has been placed on the market under a trade name. Because of its low expansion it resists heat shocks, and is declared ideal for spark plug cores. "Radio knives," used in surgery, also may benefit, since their tips need an insulating material immune to sudden heat changes.



Tubes and bars of new ceramic that heat expands only slightly

A giant transformer built to supply the current for biggest X-ray tube for cancer research

BIG X-RAY TRANSFORMER

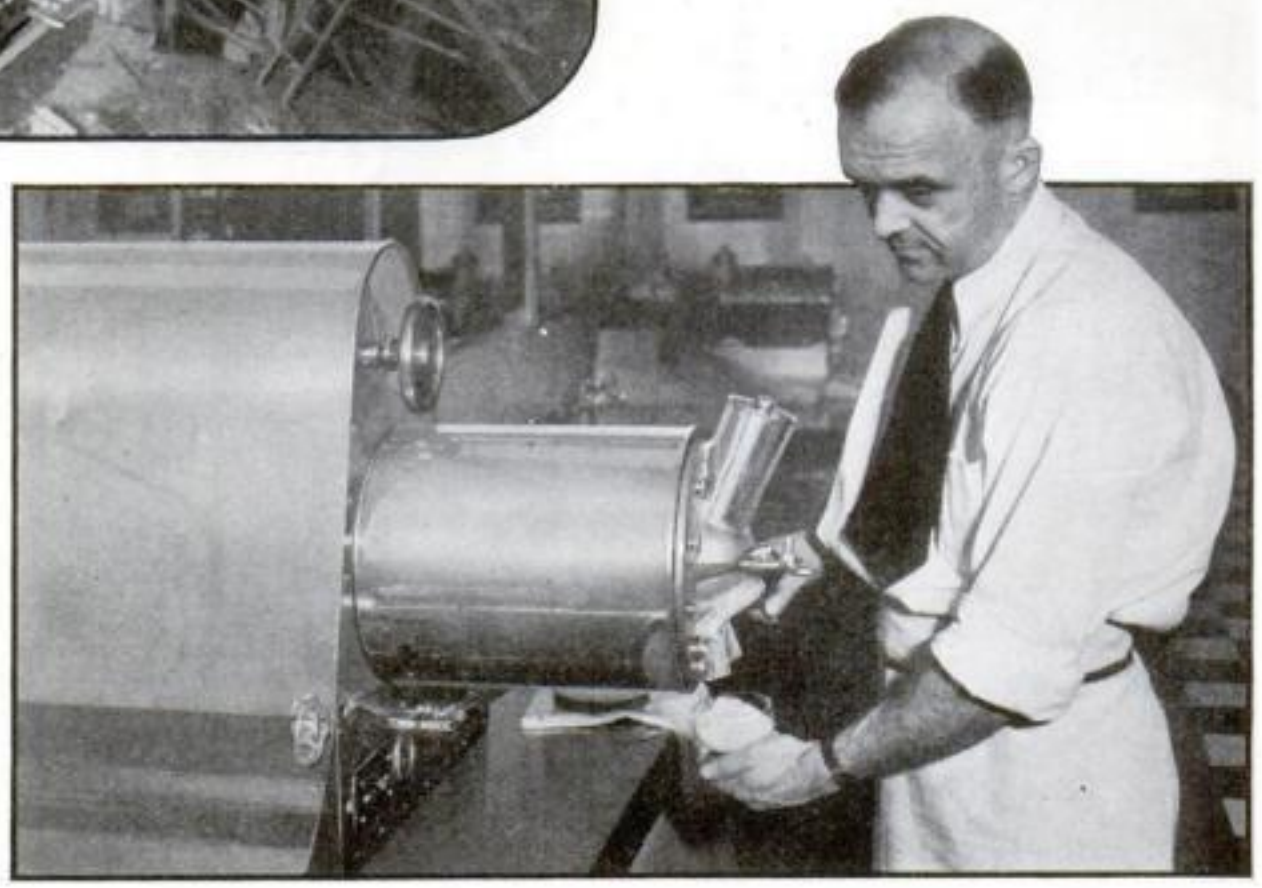
Shaped like a mushroom, an odd electric transformer of great size was recently completed at Pittsfield, Mass. Its size may be gaged by the man standing beside it. It and another like it will supply the 1,400,000-volt current needed to operate the giant X-ray tube recently completed for cancer research at the California Institute of Technology at Pasadena. Its rays will be as powerful as those given off by radium.

RIVER IN CAVE PUMPS TOWN'S WATER SUPPLY

HIDDEN River Cave in Kentucky has perhaps the most unique setting for pumping machinery of any place in the world. Two hundred feet below solid limestone is a river with a source believed to be 360 miles away. Here a twenty-seven-foot dam has been constructed. The water runs through a flume at the rate of 11,000 gallons a minute, operating a vertical turbine and turning a three-cylinder pump on a natural rock ledge about ten feet above the stream. Ninety-two horsepower are generated and used to force a six-inch stream of water from the river, thus supplying water to the town built over the cave.

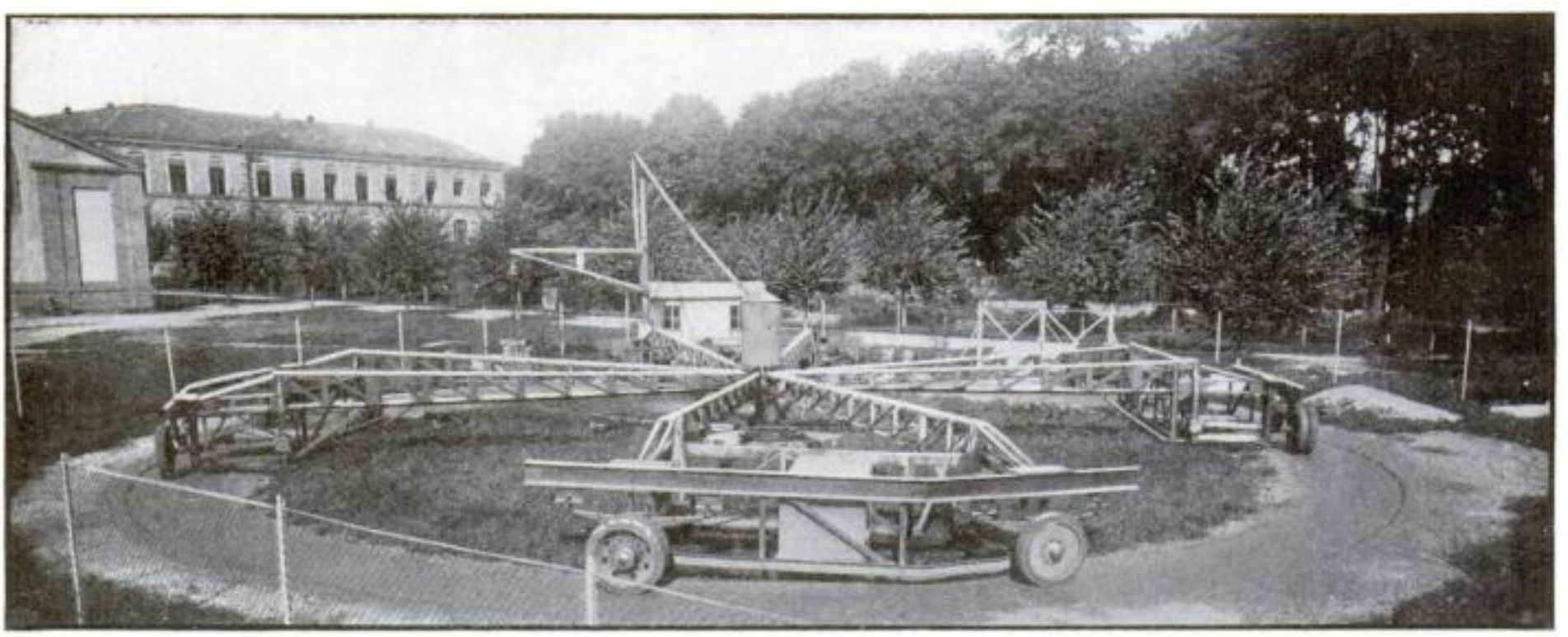
ICE CREAM FROZEN TO ORDER IN NEW FREEZER

ICE CREAM is frozen and served to order for the customer, direct from cream can to serving dish, by a new machine patented and placed on the market by an inventor of Portland, Ore. It is intended for use in restaurants, soft drink stands, and all places serving ice cream direct to customers. It freezes two quarts of soft cream every one and one half minutes. This provides an eighty-gallon capacity every day with one machine. The liquid cream is poured through a font into a revolving container, set inside brine in the small freezer head. A motor incorporated in the machine revolves the container. The inventor claims that the machine will revolutionize serving methods in the retail ice cream trade.



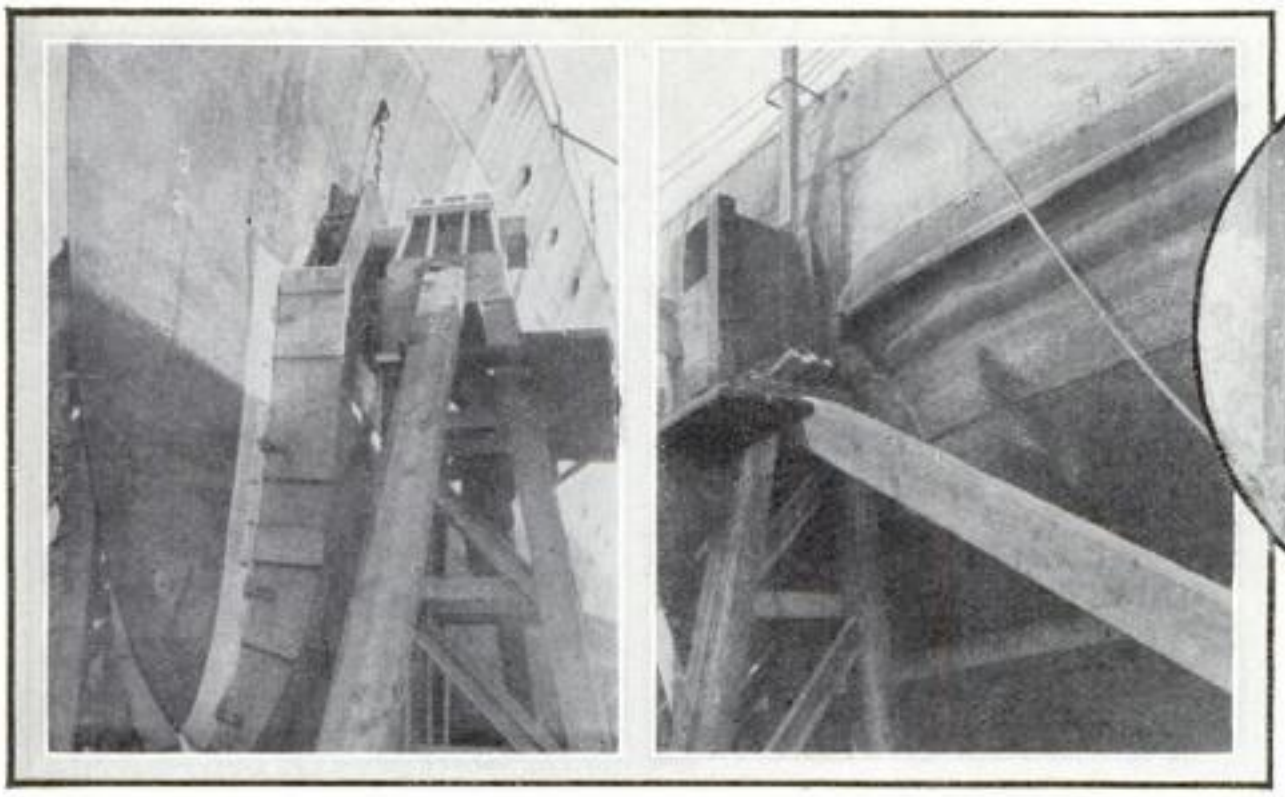
HUGE MERRY-GO-ROUND TESTS GERMANY'S ROAD MATERIAL

A ROAD-TESTING merry-go-round, constructed of huge steel girders, with eight heavy motor truck wheels forming four two-wheel chassis at the outer edge, is being operated daily in Germany in gathering data on the durability of highway materials. Scientists at the Institute for Road Construction at Karlsruhe designed the massive testing apparatus. Here various kinds of highway materials are being studied under actual conditions of wear and tear. The material is laid down in a circular strip under the outer edge of the merry-go-round. Operated by an electric motor, the huge rollers begin to turn, and day after day, the weighted wheels lumber over the narrow strip of roadway while, at regular intervals, the material is examined by experts to determine the effect of the hard usage. Wheels of different types and weights can be employed in the tests.

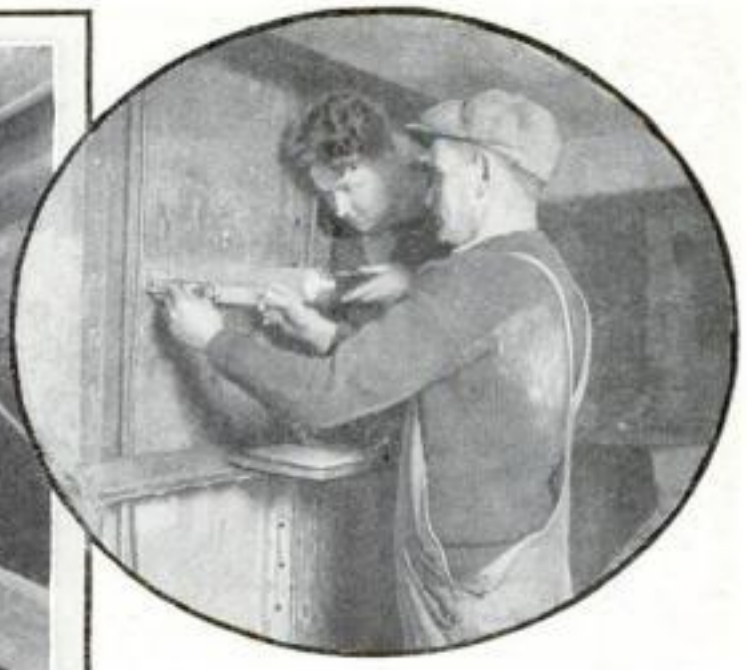


Designed by scientists at the Institute for Road Construction, Karlsruhe, Germany, this merry-go-round apparatus is operated by an electric motor which drives the weighted wheels over the paved track so that data may be gathered as to wearing quality of Germany's roads

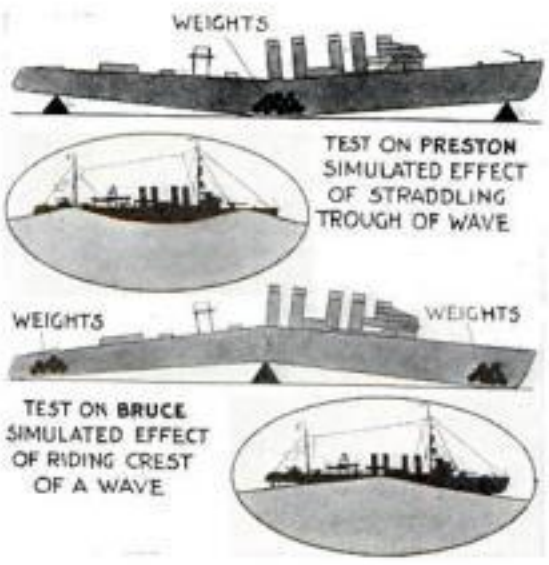
BREAK WARSHIPS' BACKS TO GAGE THEIR STRENGTH



Bow of the *Preston*, left, supported on a chock similar to one beneath the stern, while the center of the destroyer is unsupported. At right, the buckled hull of the *Bruce*, supported in center only, after breaking tests



While iron weights were piled into the *Preston* workmen operated a strain gage on its plates to study ship's strength



ENGINEERS of the United States Navy, at the Norfolk Navy Yard, Portsmouth, Va., deliberately broke the backs of two condemned destroyers recently to find out how strong these vessels were. It is possible to calculate on paper the strength of a ship, but this was the first time an attempt was made to find out how near paper calculations came to the actual strength of a full sized ship.

The destroyers *Preston* and *Bruce* were used in these novel tests. The *Preston* was dry-docked on two cradles at her bow and stern, which left her entire length unsupported between them. Weights, old iron, chains, and junk were then loaded into her amidships. Strain gages were placed at various points during the test. While her plates began to buckle visibly on the exterior of the hull and she dropped amidships down onto the dock blocking, records were obtained of the exact stresses that caused her failure.

The *Bruce* was then operated on, but instead of being placed across two chocks like a ship's lifeboat, she was supported on one cradle amidships. Weights were then loaded into her unsupported ends until they, too, dropped onto the dock's bottom. Strain gages again recorded the stresses.

Breaking the destroyers in this fashion was resorted to in an effort to reproduce actual sea conditions as far as possible. When a ship is lifted up on the crest of a big sea, her bow and stern are unsupported by buoyancy of water just as were those of the *Bruce*. When the sea falls away conditions are reversed. Ships have failed at sea under just such conditions. Such failures, however, were always emergencies and no one ever had an opportunity of gaging the stresses that caused the failures. Having definite data on the strength of full-sized ships, naval engineers hope to effect a saving in the weight of future craft without sacrificing safety.

Breaking the backs of the destroyers *Preston* and *Bruce* was carried out at night so expansion due to sun would be avoided

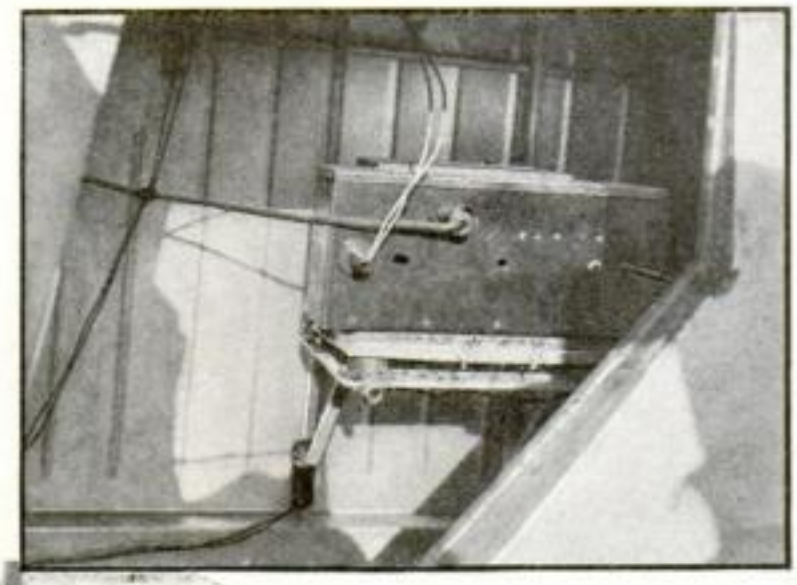
Robot runner on wheel leads young racers training at Oxford University

MECHANICAL MAN SETS PACE FOR RUNNERS

LIKE the mechanical rabbit that leads the whippets in a dog race, a robot athlete is being used to set the pace for the track men at Oxford University, England. The figure of a runner, mounted on a mechanically operated rubber-tired wheel, moves around the outside of the track at different speeds. By keeping abreast of the speeding robot, the varsity men learn to judge the pace at which they are running. The innovation is said to be of special value in training distance runners, whose success largely depends upon their ability to pace themselves so that they can reserve sufficient strength to carry them through the final sprint.

SIGNALS AID FLYERS IN BLIND LANDING

An observer, playing the part of an airplane pilot, holds a receiving loop in the midst of a magnetized field during small-scale tests of a new radio aid to blind landings



This equipment was installed in a plane to test the signals from a magnetized field

FLYERS of the U. S. Army at Patterson Field, Dayton, Ohio, soon will be able to practice blind landings on a magnetized field. Cables are being laid in concentric rings just below the field's surface. These will be energized by low-frequency electric current, establishing a magnetic field extending around the airdrome for a radius of about five miles from its center. Instruments in a plane, actuated by this magnetic force, will inform a pilot by audible and visible signals when he is approaching the field, when he has come above the landing area, and when he can level off for landing. Preliminary tests on modified full-size apparatus have shown these signals distinctive and unmistakable up to heights of 3,000 feet. They would be especially useful to guide pilots attempting a landing in a heavy fog.

Pole for beach parasol has a screw tip which makes it easy to twist it firmly into the hard sand

BEACH PARASOL'S POLE SCREWS INTO THE SAND

THE USUAL struggle in setting up a beach parasol at the seaside is obviated by a new auger attachment for the end of the pole. Cast of aluminum, the screw tip makes it possible to twist the pole into hard sand with the hands, so firmly that it will not tip over or blow down. A Los Angeles, Calif., mechanic invented it.

TOURNIQUET CONDEMNED

TOURNIQUETS, drawn taut about a limb to stop bleeding, were condemned as obsolete and unsafe by speakers before a recent international congress of medicine. By stopping the circulation, one Belgian physician declared, they promoted infection.

WHIRLING DOOR GUARD KEEPS THE FLIES OUT

AN INGENIOUS shoo-fly attachment for screen doors, designed to keep insects from entering when the door is opened, has recently been placed on the market. Its spring serves the double purpose of closing the door and actuating a whirligig rimmed with streamers of cloth ribbon. The flying ribbons are said to be effective in shooing away flies while the door shuts.

CHARCOAL MADE BY PRIMITIVE METHOD

WHILE other methods used in the United States Mint at Philadelphia have kept pace with progress, the high grade of charcoal necessary in making the dies for coining gold and silver money is still burned from selected oak in the most primitive way, and ground and pulverized in an old water mill. One man has supplied it for forty years. John R. Rowand, of East Clementon, N. J., still burns his charcoal the way his father did, burying the oak logs in sand and allowing them to char slowly. The charred logs are then carefully treated in the pulverizing mill, and freed of sand and all foreign matter. The process consists of burning selected oaken logs with the air all but excluded by a blanket of earth. Skill is needed to know just when to stop the process.

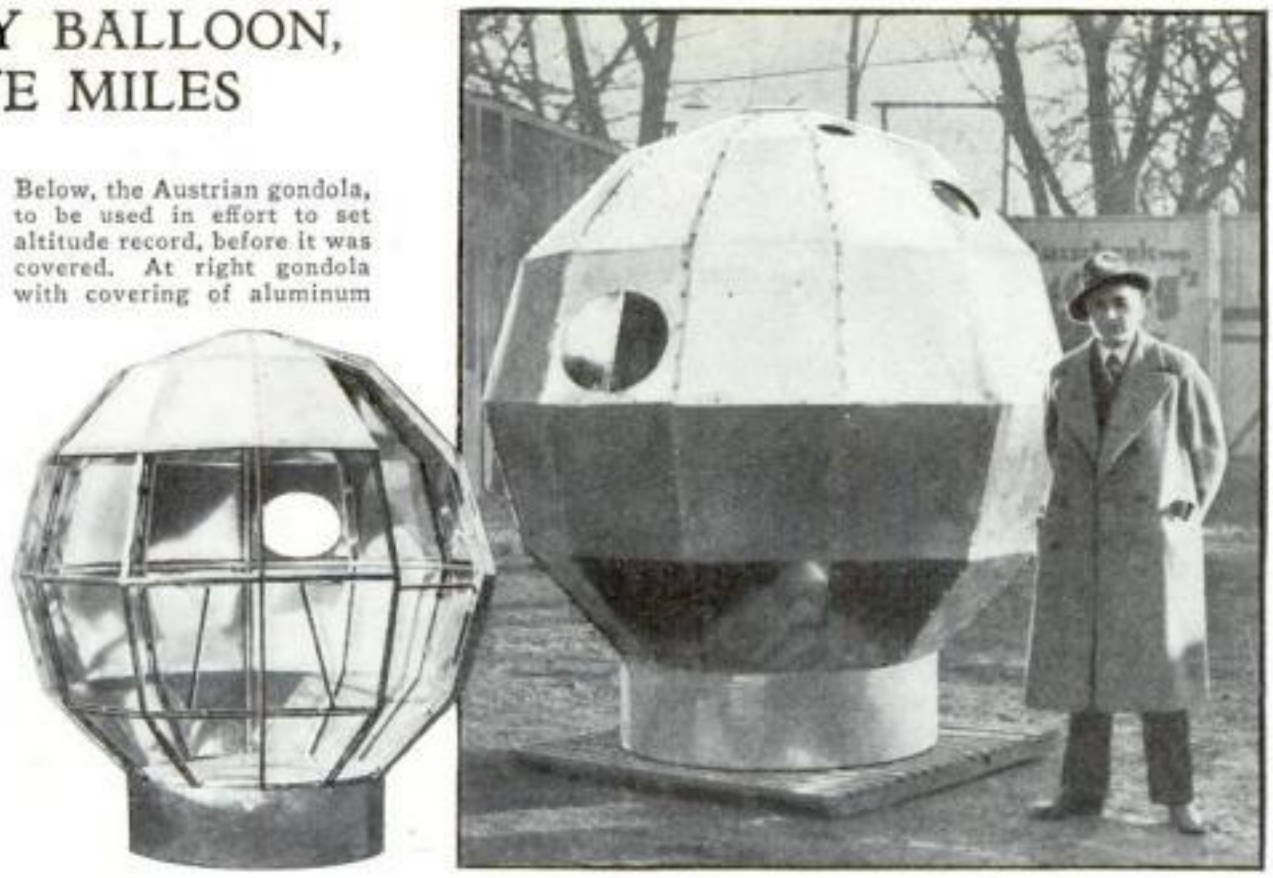
Right, uncovering the special charcoal used in mint at Philadelphia. Above, one of the charred logs ready to go into the pulverizer

GONDOLA, LIFTED BY BALLOON, MAY RISE TWELVE MILES

AUSTRIAN engineers recently obtained their first glimpse of the air-tight gondola in which Count Theodor Zichy and Hans von Braun, of Vienna, plan an ascent to a world's record height of more than twelve miles above the earth. The odd cabin, with its passengers sealed in, is to be swung beneath a huge balloon on its upward journey, and the descent is planned by cutting loose the gondola and letting it fall at the end of a large parachute.

Meanwhile other nations are racing for the honor of the highest ascent. Prof. Auguste Piccard, Swiss physicist who started the competition with his daring ten-mile ascent in an air-tight ball, plans another try. Two British aviators are building a balloon for a seventeen-mile-high flight, and Russian aviators are preparing for a twelve-mile ascent in 1933.

Below, the Austrian gondola, to be used in effort to set altitude record, before it was covered. At right gondola with covering of aluminum

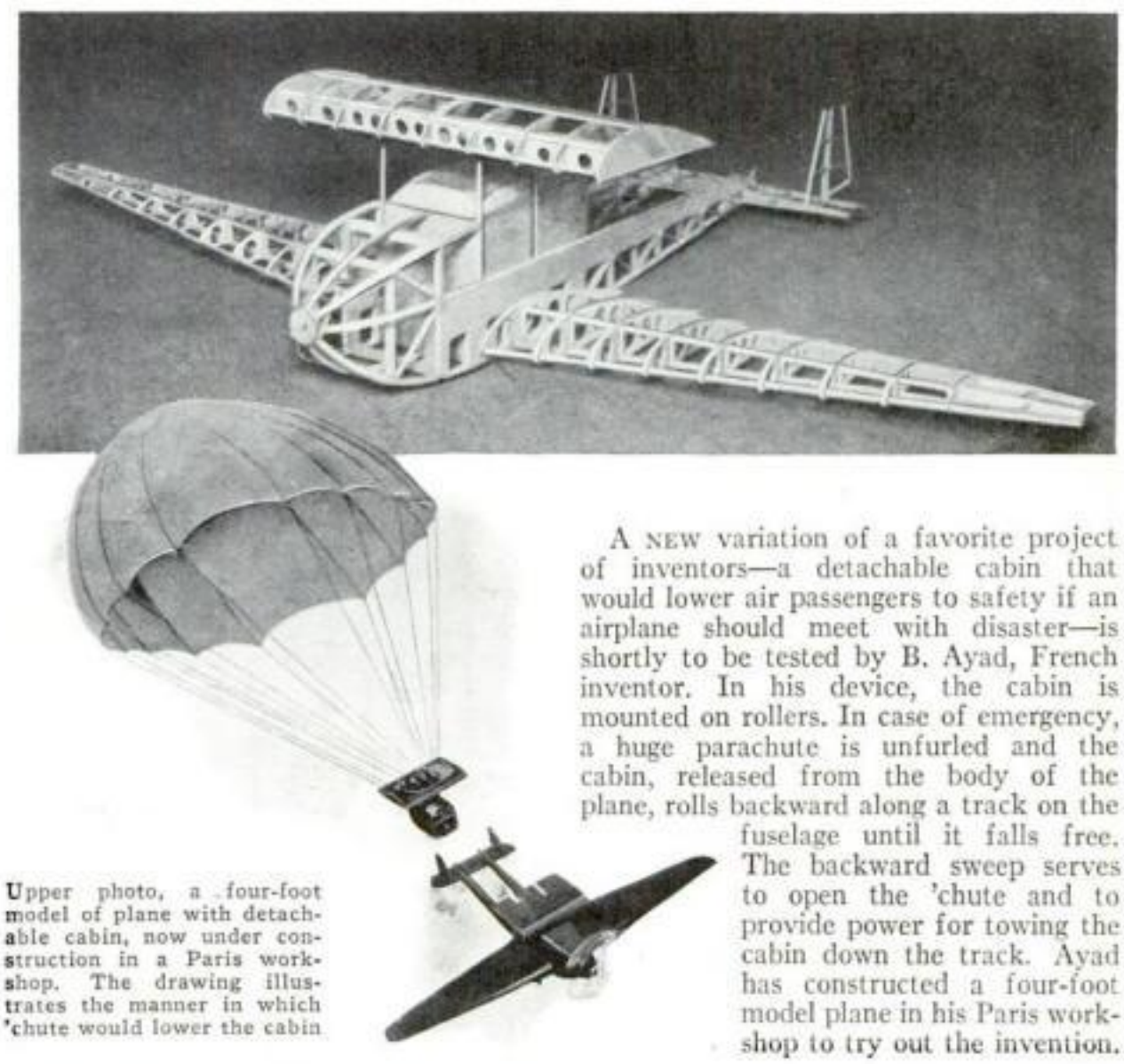


NEW SMOKE BOMB WARNS ALIEN FLYER TO LAND

DEPRIVED of fighting airplanes by the treaty that ended the World War, Germany's sole air defense now consists of signal bombs. This new method of signaling to alien planes was put into effect after the frequent maneuvering of Polish aircraft over German soil had irked the frontier population. At the approach of a plane a smoke bomb is fired from a mortar. It then explodes with a burst of colored smoke, which continues as the bomb descends on a parachute, warning the offending pilot to land or turn back. Just what procedure would be followed if the pilot disregarded the signal is a problem the officials have not yet had to face.

German soldier firing a smoke bomb to warn away alien flyer. Above, plume of colored smoke released by the bomb

PARACHUTE LOWERS AIRPLANE'S CABIN



A NEW variation of a favorite project of inventors—a detachable cabin that would lower air passengers to safety if an airplane should meet with disaster—is shortly to be tested by B. Ayad, French inventor. In his device, the cabin is mounted on rollers. In case of emergency, a huge parachute is unfurled and the cabin, released from the body of the plane, rolls backward along a track on the fuselage until it falls free. The backward sweep serves to open the 'chute and to provide power for towing the cabin down the track. Ayad has constructed a four-foot model plane in his Paris workshop to try out the invention.

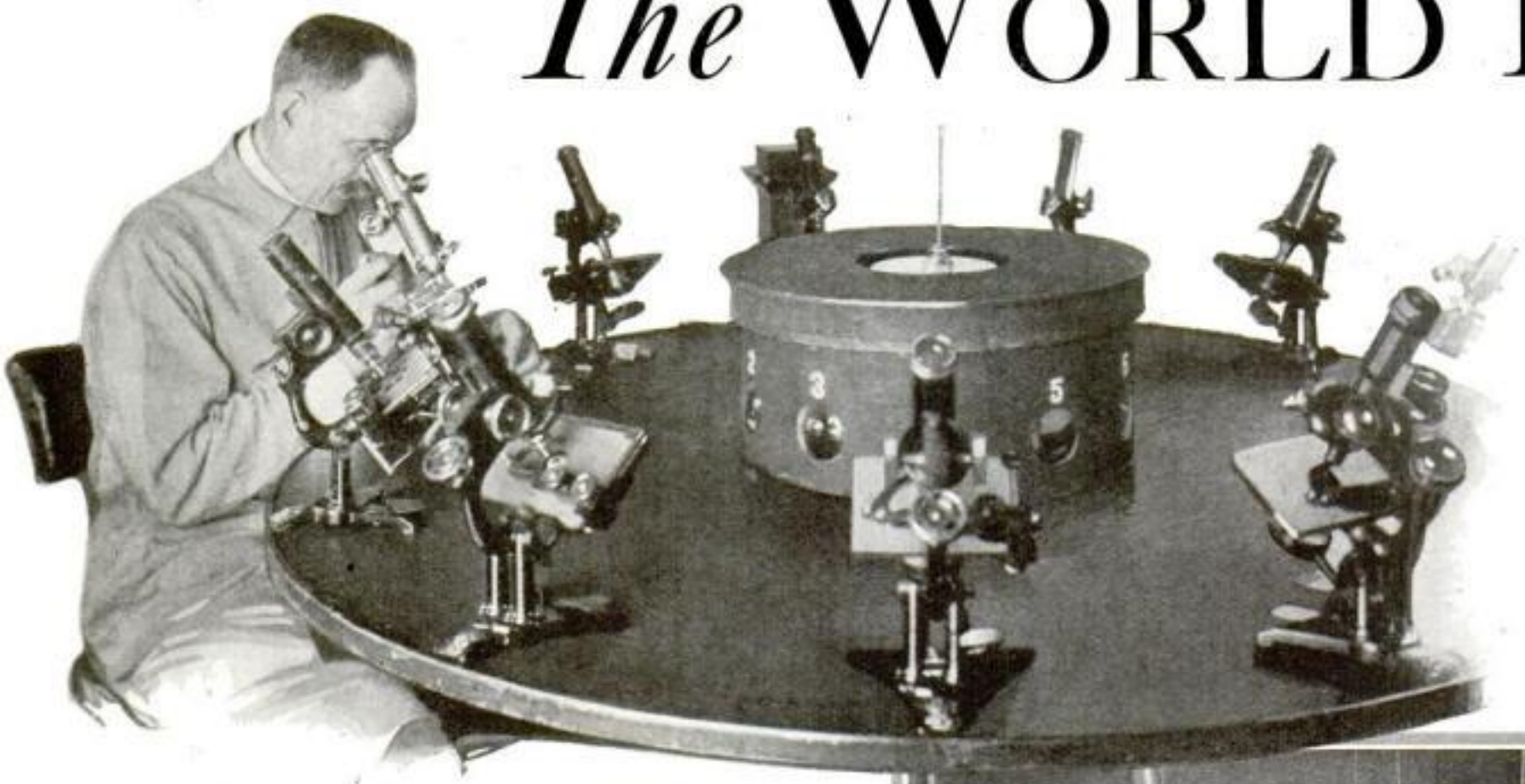
Upper photo, a four-foot model of plane with detachable cabin, now under construction in a Paris workshop. The drawing illustrates the manner in which 'chute would lower the cabin

Rotated by compressed air, pencil cuts letters on steel

REVOLVING PENCIL WRITES ON STEEL

INSCRIPTIONS may be written on steel, glass, and lead-coated surfaces with a whirling "pencil" recently placed on the market. A tiny cutting tool at the head of the instrument is whirled by compressed air. It rotates at the rate of 40,000 revolutions a minute. At this speed the pencil cuts as fast as the hand moves. The "pencil" is intended for use in marking articles in tool rooms, laboratories, and stock rooms.

New Discoveries Prove The World Is



Nemas at different stages of development are mounted under the microscopes on this table so that their history can be studied by Dr. N. A. Cobb, nematologist of the U. S. Department of Agriculture. The table revolves and each specimen can be viewed in turn

To make a drawing of nemas the microscope, headrest, chair, drawing board, and mirror are mounted to solid steel to prevent vibration. The mirror throws on the paper an image of the microscope's enlargement of the specimen so artist can draw it

THE world, and almost all that is in it, literally is alive with worms!

That is the startling discovery of scientists who are studying the habits and characteristics of a huge family of mysterious wormlike creatures called "nemas." So all-pervasive are these strange crawling things that, if everything except nemas suddenly became transparent, you still would be able to recognize the outline of many of the trees, plants, and animals around you, for all of them are virtually swarming with these queer worm forms.

Fantastic though this picture may seem, it nevertheless is based upon fact. Nemas infest the earth from pole to pole. The Arctic and the tropics alike abound in them. They thrive equally on the floor of the ocean and in the rarefied air of mountain tops. They are the worst enemies of the farmer of the North, the planter of the South, the rancher of the West. Experts estimate they destroy $100,000,000 worth of livestock in this country yearly. The value of the crops and trees they devour is incalculable.

Even man himself is not immune from the nema's attacks. The hookworm, which lives in the small intestine of its human victim, sucking his blood and thus causing anemia, heart disease, and mental and physical lassitude, is a member of the numerous nema family. The Rockefeller Institute has spent $5,000,000 on hookworm control in tropical and sub-tropical countries. Since this organization merely shares with various governments the expense of combating the disease, the total sum spent in fighting hookworm is many times $5,000,000. Yet the hookworm is but one of more than a hundred species of nemas that prey on human beings!

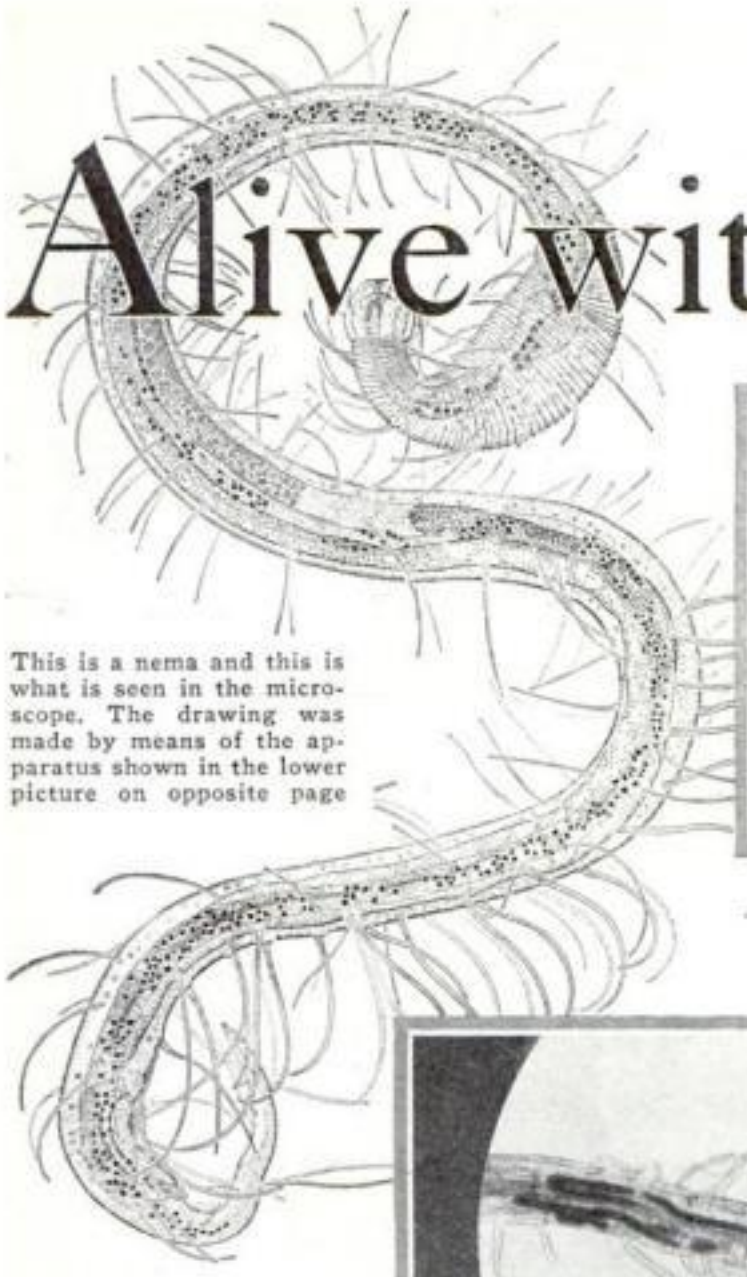
What are nemas? Put that question, as I did, to an authority on the subject, and he will begin by resorting to negatives to describe them. They are not insects, worms, or snakes, although most of them resemble worms and snakes. The largest species known is nearly forty inches long; the smallest measures only one two-hundred-and-fiftieth of an inch from head to tail. But whatever their length, they always are slim and flexible. Usually their bodies have no protuberances, but a newly discovered deep-sea species is equipped with a multitude of strange, feelerlike "legs." Nemas take their name from a Greek word meaning yarnlike or stringlike.

It was Dr. N. A. Cobb, nematologist of the United States Department of Agriculture, at Washington, D. C., who told me about these amazing creatures that have multiplied and spread until they almost may be said to dominate the earth. "Nematologist?" Yes. So important have they become that a new science—the science of nematology—is being built around them in an effort to produce better crops, sturdier herds of livestock, and healthier people.

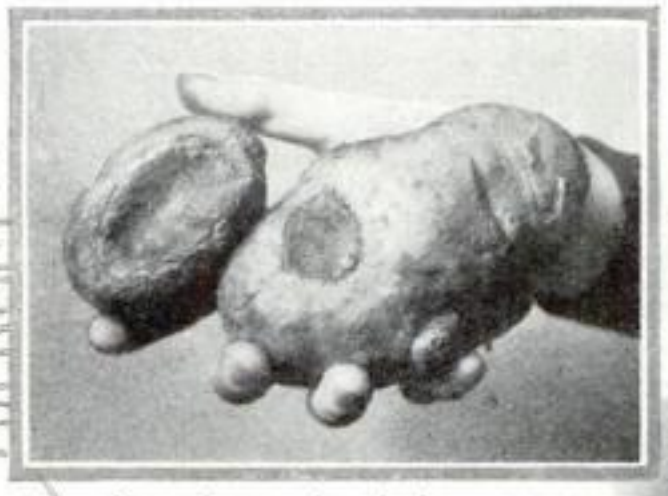
Today, Dr. Cobb told me, about 5,000 different species of nemas are known. Nematologists feel that, despite many discoveries made in recent times, they still are standing on the threshold of their new science. Staggering though the figure 5,000 may seem, it represents but a small proportion of the total number of nema species believed to exist. From the rate at which new types are being found, and the widely scattered area they are known to inhabit, the number of different kinds of nemas infesting the earth is estimated to run into the millions!

By Clayton R. Slawter

Alive with WORMS



This is a nema and this is what is seen in the microscope. The drawing was made by means of the apparatus shown in the lower picture on opposite page



Nemas have got busy in these potatoes as is evident from the scars on them

At right, a photomicrograph of a wheat root badly infested with nemas. It is in this way that the wormlike things destroy much grain

After earth containing nemas is placed in this cylinder, water is fed in and the cylinder rotated. The nemas are thrown to the top

Nemas, I learned, are by no means the most primitive form of life. They have heads and tails, and right and left sides. With the exception of lungs, heart, and blood vessels, they have as many internal organs as we have. Most nemas are transparent. Some have the beginnings of eyesight; that is, they are light-conscious and react differently to blue light and infra-red rays. Unlike bacteria, nemas in most cases cannot be bred in laboratory cultures.

BROADLY speaking, nemas fall into two large groups—the parasitic species and the free-living types. Parasitic nemas begin life in the ground, but soon infest and subsist at the expense of everything that grows in and on top of it, including man. They are the ones that cause all the damage and disease. The free-living species inhabit the ground like ordinary earthworms.

On the whole, these free-living nemas are not so unfriendly to man as are their cousins that prey on his crops and cattle. One expert has even gone so far as to say that it would be impossible for man to inhabit some parts of the globe in which he now lives without the protection of these nemas.

Have you ever noticed that grasshopper plagues only appear in certain parts of the country? Have you observed that in New England, for example, grasshoppers do not appear in swarms as they do in more western states? Dr. Cobb has, and he has made a study of the matter. As a result of his work along these lines, he is inclined to attribute the New England farmers' immunity from grasshopper plagues to a nema commonly known as the hairworm.

Dr. Cobb spent many nights lying out on the ground, studying the feeding habits of New England grasshoppers. The long-leaved plantain, which grows in profusion in that part of the country, he found to be their chief item of diet. In nearly every case, in fields where grasshoppers died in the autumn after a steady diet of this plant, the insect was found to be infested with hairworms.

Specimens of the long-leaved plantain then were brought into the laboratory. There, under the microscope, it was revealed that parent nemas of this variety were careful to deposit their eggs on the long-leaved plantain and similar forage plants at exactly the height from the ground at which grasshoppers grazed. Thus, the grasshoppers, while partaking of their favorite meal, swallowed nema eggs along with it.

IN TIME these hatched, and the unfortunate grasshopper became the host of a nema, busily engaged in devouring it from the inside out. When, after six weeks, the grasshopper finally succumbs to the ravages of the parasite, there emerges from its empty carcass a white, writhing, snakelike nema many times longer than its late host.

Before the Christian era, ancient Vikings had in their mythology a creature they called the Midgaard serpent. This was, they believed, a huge snake that held in its coils the entire world. Could one of those old Norsemen return to earth today and take up the study of nematology, he might have reason to think himself studying the Midgaard serpent.

FOR the writhing coils of the multitudinous nema family may be said to embrace the entire globe. Wherever there is food for nemas, some species are sure to be found. They thickly infest the moss-like growths of Arctic muskeg swamps. Scientific parties, making soundings in the Antarctic Ocean, dragged up on their gear from the bottom of that icy sea nemas in great numbers. Members of one party dug down to the bottom of an ice-filled hole on the shores of the Antarctic continent. Ice from the bottom of the hole was melted in a pot, releasing numbers of nemas alive and well! How long water in the hole had been frozen solid there was no means of telling, yet the nemas when thawed out appeared to have suffered no harm from their imprisonment in the ice.

At the top of Long's Peak, Colo., where the only soil is in the cracks of rocks, and the only *(Continued on page 115)*

Emergency Aids *for the Sick*

WITH the aid of ingenuity and a few materials to be found in every household, any home may be converted into a temporary hospital. Ten aids to home nurses, illustrated on this page, were suggested by a Chicago trained nurse. They will suggest, in turn, other ways to make invalids more comfortable, and to supplement the limited contents of the average medicine chest. The pictures show how such simple things as adhesive tape, pins, glasses, socks, and palm leaf fans may be pressed into service and made to meet emergency needs in the sick room.

CURE THAT COLD. With a pitcher, a piece of rubber tubing, and a Turkish towel an inhaler can be quickly arranged with which colds of all kinds can be satisfactorily treated. One end of the tubing is placed inside the pitcher, and towel confines the vapor

HELPING THE NERVES. When a patient is annoyed by the tick of a watch place a glass tumbler over it and the tick can't be heard, but the face is still visible

MAKE YOUR OWN TRAY. Any old discarded picture can be pressed into service as a convenient sick-room tray. Waxed paper, placed upon it, will keep the improvised tray clean

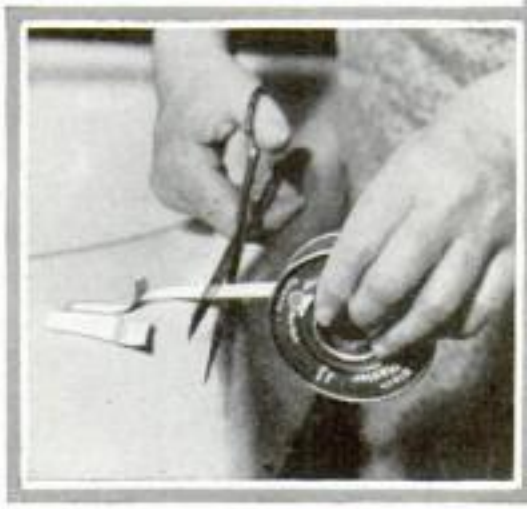
TO PROTECT THE EYES. A palm leaf fan, stuck in a vase, makes a satisfactory shield to keep bright light out of the invalid's eyes

FOR A QUIET ROOM. Slamming doors are quieted by wrapping a pair of socks around the knobs, as shown in above photo

A HANDY WRINGER. Your potato masher can be used to wring out hot compresses and thus avoid burning the hands

POISON! To guard against taking poisonous medicine by mistake, stick pins into the cork

NO STICKY FINGERS. In cutting strips of adhesive tape, stick the free end to a washbowl so that it will not cling to the fingers



HOT SALT BOTTLE. When a hot water bottle develops a leak don't throw it away. Filled with hot salt it is excellent to use for the local application of heat

HOMEMADE ICE BAG. Take a piece of kitchen oilcloth, put ice on the oiled side, gather the corners together, tie them securely, and there you have an ice bag

Radio Squeals *turned to* MUSIC FOR ENTIRE ORCHESTRA

ONE of the world's strangest orchestras recently gave its first public recital at Carnegie Hall, New York City. Music came not from the varied instruments in the hands of the performers, but from a row of loudspeakers. The electrified instruments were the inventions of Prof. Leon Theremin, Russian physicist now living in New York. Several years ago, Theremin designed a strange instrument with which he produced music by waving his hands in the air. Its secret was the harnessing of the "squeal" of a radio vacuum tube, so that a performer might create musical tones of any desired pitch or volume by making passes at two metal rods or antennas protruding from a cabinet.

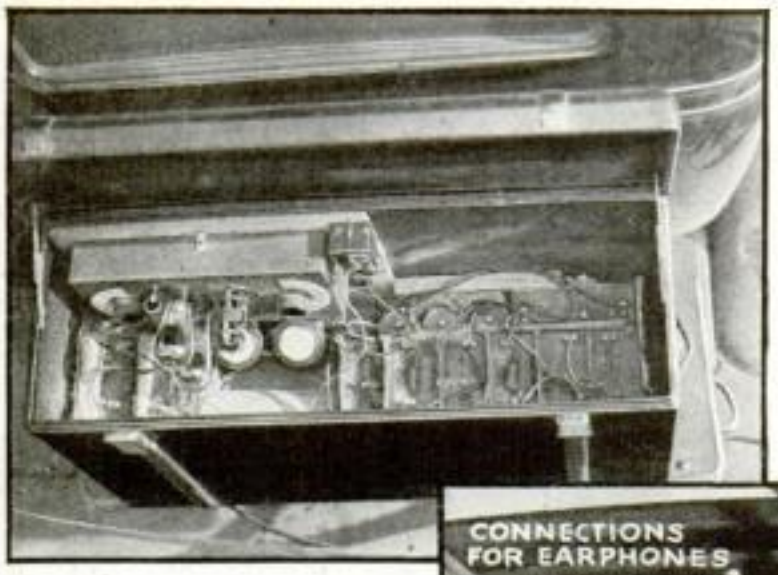
Now Theremin has produced more elaborate instruments based on the same principle. One, his "fingerboard Theremin," gives cellolike tones. It has no strings; the musician merely slides his fingers up or down the scale, while his other hand operates a lever like a pump handle, controlling the volume. "Keyboard Theremins," resembling small pianos but with hornlike tones, are another of his inventions. Strangest of his new creations is a platform on which a dancer plays a tune by the movements of her body. Waving the arms governs the pitch, and stooping or rising, the volume.

Movements of dancer on this musical platform control vacuum tubes so that rhythmical motions are translated into tones that are heard over loudspeaker

With this huge bank of vacuum tubes Prof. Theremin conducts experiments in his laboratory which led to a harmonious reproduction of the radio squeals

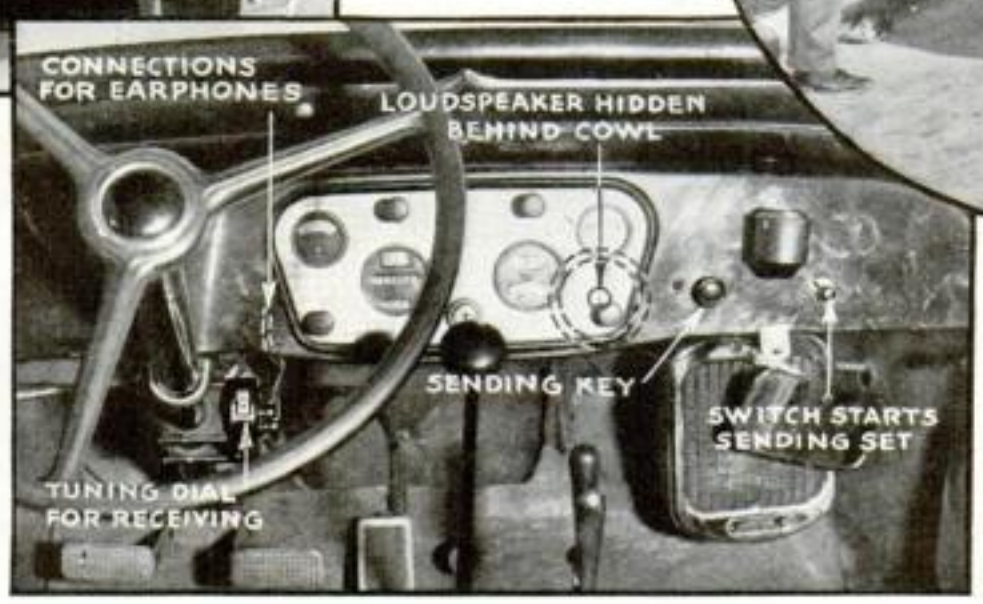
In circle, the new keyboard Theremin which is designed in the form of a piano to produce synthetic music. At left, Prof. Theremin slides his fingers up and down a fingerboard to regulate the pitch of the electrically formed notes with cello tone

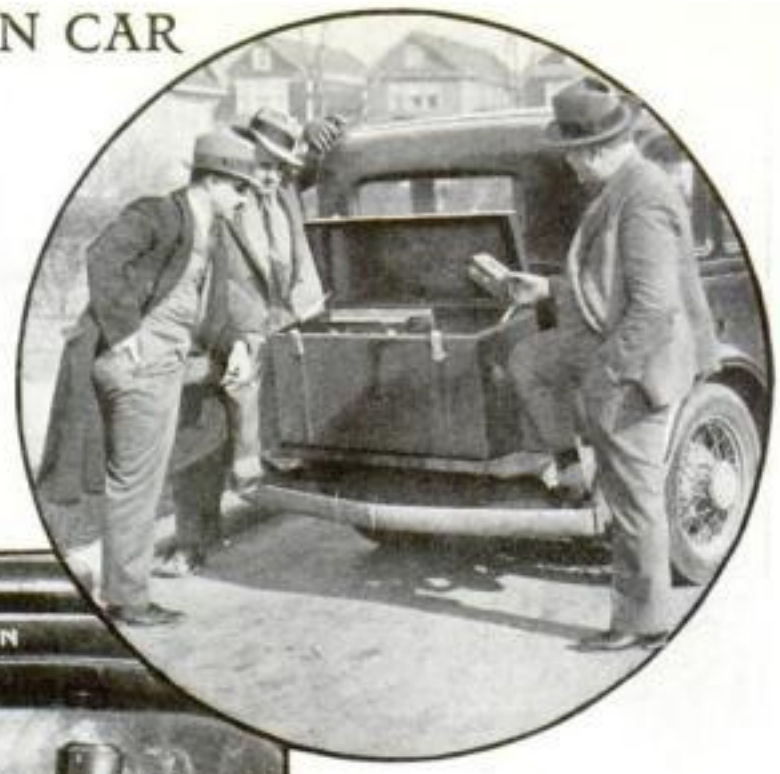
VANISHING RADIO STATION FOUND IN CAR



Federal agents found this radio transmitting outfit hidden in the trunk on the rear of a car

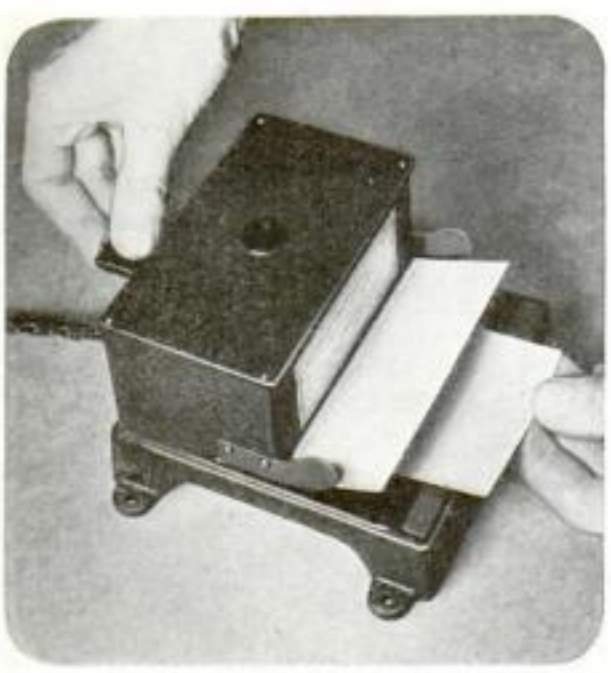
Below, picture of the instrument board of a bootlegger's car showing how controls that worked a radio sending set were camouflaged as part of the ordinary accessories





The vanishing radio outfit was discovered concealed in this sedan

BY TRACING a vanishing radio station to a bootlegger's automobile, Federal agents recently achieved one of their most brilliant exploits. Hitherto rum runners of the Atlantic seaboard have used permanent land stations to keep in touch with liquor ships offshore. When an illicit station on Long Island, N. Y., was heard recently sending code messages, Federal men traced it with direction finders, by methods described in the article beginning on page 13 of this issue. When they swooped down upon the spot to raid it, all they found was a vacant lot. Hardly had they returned from their futile hunt when the station resumed sending—this time from a new location. For two months the phantom station eluded the agents. Then they descended in a surprise raid upon a Rockaway, N. Y., private garage, and the mystery was solved. In a small sedan, they found a complete sending and receiving radio outfit. The transmitter, they said, had a thirty-mile range and was operated from camouflaged controls on the car's instrument board. When Federal agents were too hot on the scent, the car would simply move to a new location, a scheme that worked well until the raid upon the garage.



LIGHT PRINTS DATA ON PHOTOGRAPHIC FILM

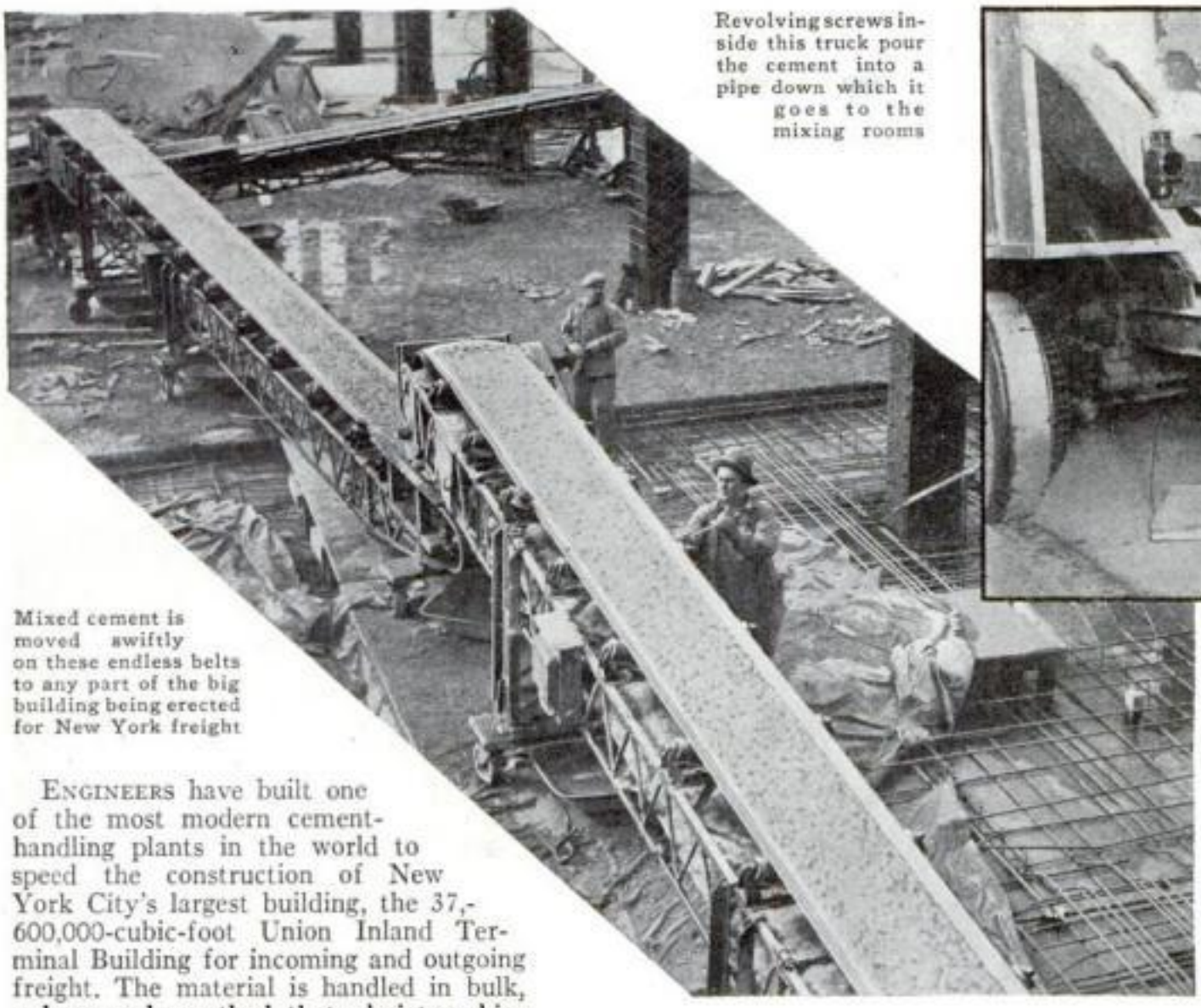
TITLES, dates, and other useful information may be printed permanently on the edge of a photographic film negative just before development, with the aid of a new device called a margin printer. Data are written on the edge of a standard three-by-five-inch index card, which is slipped into a slot in the machine. The cut film is inserted in another slot. Pressing a lever brings negative and card in contact, and lights a five-watt electric lamp that does the printing. Only a small slit on the negative margin is illuminated, so the rest of the negative will not be fogged. When the picture is developed and printed, the title appears in black on white.

BOAT ON ROLLERS IS AIR PROPELLED

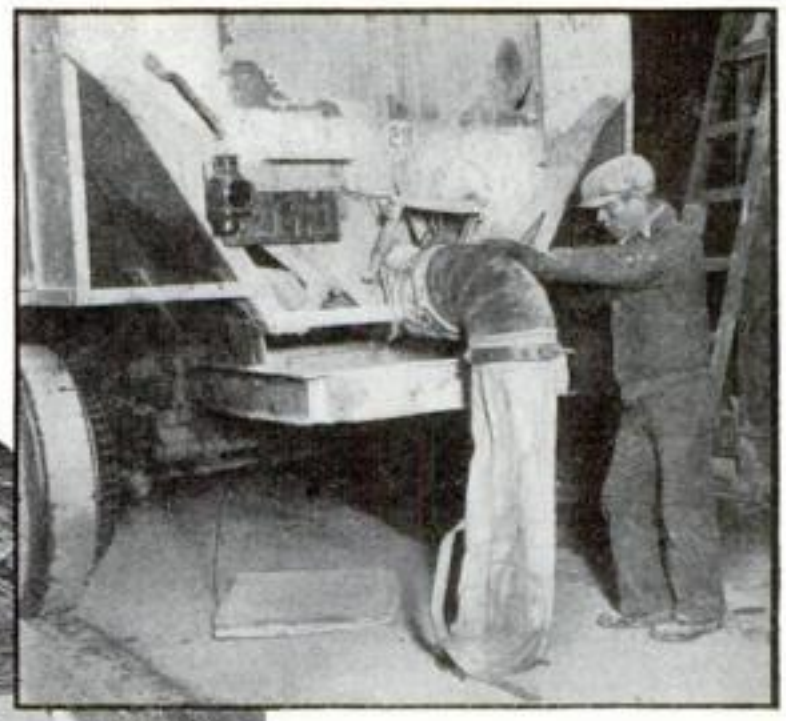
Three barrel-like rollers support this strange boat, which is driven by an air propeller whirled by a nine-horsepower motor. Because of its buoyancy it is expected to make 90 miles an hour

SKIMMING over the water on three barrel-shaped rollers that act as revolving pontoons, a remarkable air-driven boat is expected by its inventor to attain a speed of nearly ninety miles an hour. A nine-horsepower motor drives the airplane propeller mounted at the rear. The designer, a French engineer named Eckerlein, declares that high speed with such a small power plant is made possible by the reduction of water resistance to a minimum, since there is no hull of conventional type to cause a drag. The barrels, water-tight and air-filled, supply the buoyancy that reduces displacement and raises the speed limit.

Automatic Machines Lay Concrete in New York's Biggest Building



Mixed cement is moved swiftly on these endless belts to any part of the big building being erected for New York freight



Revolving screws inside this truck pour the cement into a pipe down which it goes to the mixing rooms

ENGINEERS have built one of the most modern cement-handling plants in the world to speed the construction of New York City's largest building, the 37,600,000-cubic-foot Union Inland Terminal Building for incoming and outgoing freight. The material is handled in bulk, a large-scale method that obviates shipping it in bags.

Cement arrives in moisture-proof cars, and is mechanically transferred through pipes into an overhead storage hopper of 500-barrel capacity. Special trucks with dust-proof bodies are filled by gravity and convey the cement to the building site. Here a spiral screw within the truck revolves and ejects the cement through a spigot, down a canvas tube, and into an underground bin. The trucks can be unloaded in five minutes. Thence the cement is propelled by revolving screws through pipes to the mixing plant, being weighed automatically into batches along the way. Finally the cement mixture is carried on endless belts to the point where it is being laid. These conveyor belts can be moved easily into the position desired so that the cement goes immediately to any part of the work where it is needed. The entire operation is swift, dustless, and free from waste, eliminating the considerable expense of bags and also doing away with the loss due to the cement adhering to the bags when they are being emptied.

METAL REFLECTOR GIVES QUICK COAT OF TAN

IMPATIENT sun bathers who yearn for facial coats of tan may now speed up the process, it is said, with the aid of a new German mirror of odd design. This polished metal reflector, worn about the face, concentrates sunlight by the use of multiple mirror surfaces. Its use is recommended especially for sun bathing on hazy days, and during winter months when the sunshine is less intense than in summer.

This metal reflector helps the sun tan you

U. S. ARMY'S NEW MORTAR IS PORTABLE

Three men are able to carry this new portable trench mortar developed by the U. S. Army

SO LIGHT that three men can carry it, a new portable trench mortar, developed by the United States Army, is considered an unusually deadly weapon because of its destructive power and ease of operation. Despite its light weight, the gun is extremely accurate up to the limit of its two-mile range. Its eighty-one-millimeter (approximately three-inch) shell is fired by dropping it down the barrel, where it strikes a pin at the base and sets off the firing charge. The barrel, tripod support and base come apart for transportation. The new portable trench mortar is shown in photo below set up and ready for firing.

AIR-FILLED PONTOONS TO RAISE LOST TREASURE SHIPS

How sunken treasure ships may be raised from depths beyond a diver's reach was demonstrated in a New York laboratory recently by Giuseppe Bontempi, inventor of "grappling pontoons." Miniatures of these new devices successfully raised a four-foot ship model from the bottom of a tank of water.

U-shaped frameworks of steel are first lowered to the sunken ship, and attach themselves automatically to the hull near the bow and stern, grasping it like tongs. Motors on these frames then pull down a pair of pontoon-bearing members. The pontoons are made buoyant by air pumped from the surface, bringing up the derelict, while lines anchored to ballast on the ocean bottom regulate the ascent, as shown in the accompanying photograph made during the demonstration.

USE MOTOR PISTON AS PILE DRIVER HAMMER

GASOLINE will drive piles, as well as automobiles, according to reports from Leipzig, Germany, where a pile driver of unusual construction was demonstrated the other day. Taps from the piston of this new machine's one-cylinder, air-cooled motor speedily force a heavy timber home, it is said. The compact mechanism contrasts strikingly with the towering derricks of the conventional pile driver that uses a falling weight. The inventor claims his pile driver can be set up more quickly and occupies less space than usual types.

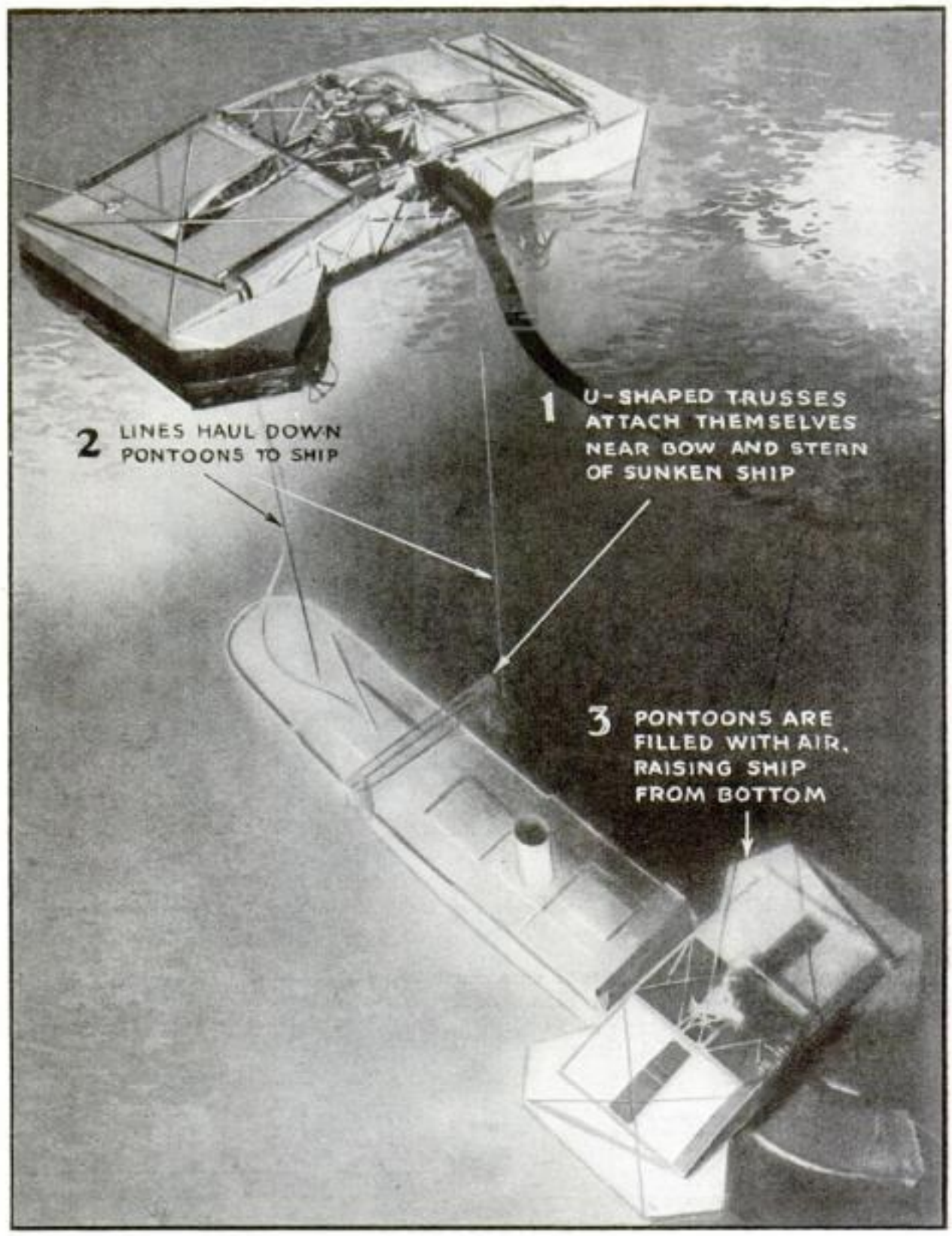
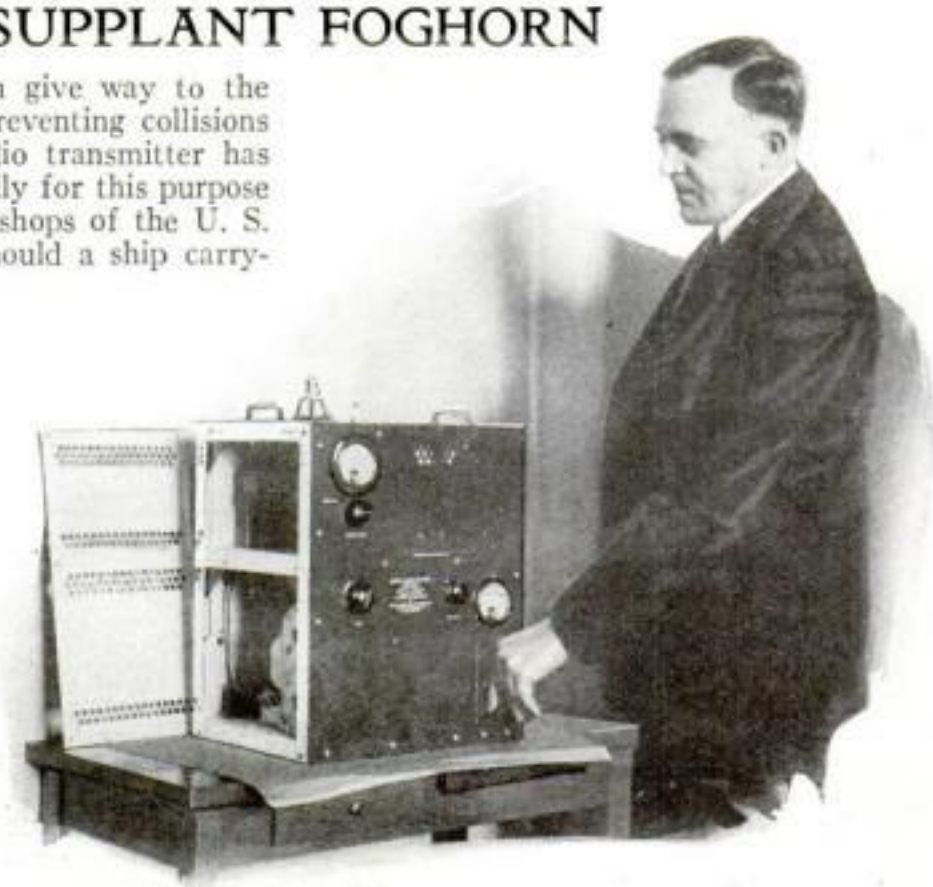


Photo-diagram shows how air-filled pontoons, in connection with U-shaped trusses that automatically attach themselves to bow and stern of a sunken ship, may be used to raise vessels from deep water

RADIO TO SUPPLANT FOGHORN

FOGHORNS may soon give way to the radio as a means of preventing collisions at sea. A portable radio transmitter has been developed especially for this purpose at the Detroit, Mich., shops of the U. S. Lighthouse Service. Should a ship carrying such an apparatus run into fog the set, put into operation, sends out wireless signals in a distinctive code. Any radio compass equipped vessel near at hand can pick up this signal and so determine the exact position of the sending vessel; and, by repeated observations, detect the course of the approaching ship.



SCREWCAN'T WORK LOOSE

VIBRATION or bending of the material in which it is sunk cannot cause a wood screw of a new type to work loose, according to the manufacturer. Near the base of the thread on opposite sides, two sets of sharp-pointed wings flare from the shank. They offer no resistance as the screw is driven home, but any reverse motion causes them to dig in so the screw cannot work out. Using extra pressure, it can be removed with a screw driver.

Wings on thread hold wood screw in place

PULLEY HAS VACUUM CUPS TO GRIP BELT

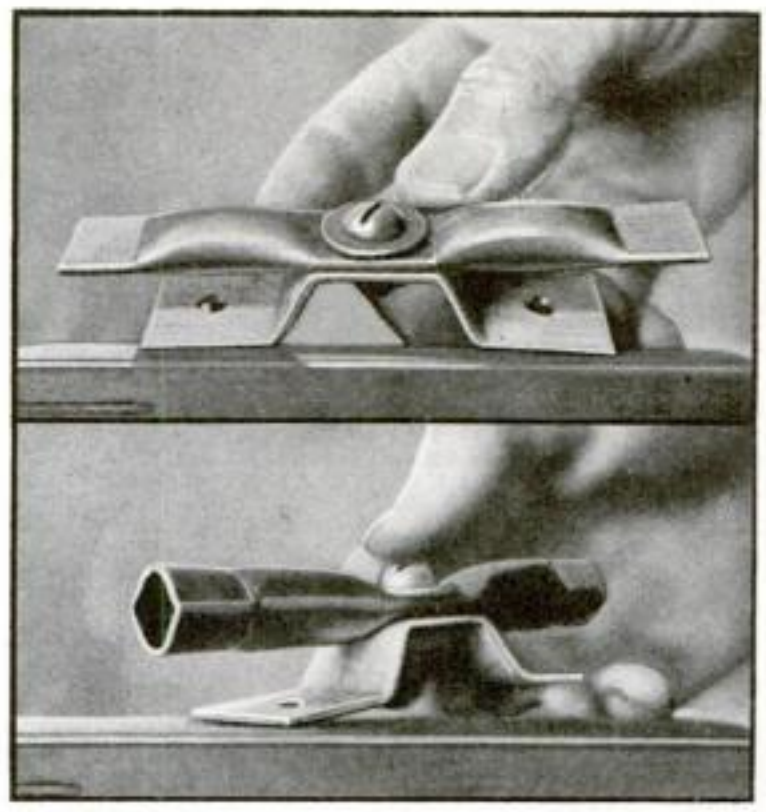
Pulley, dotted with vacuum cups, grips the moving belt and prevents it from slipping

DOTTED with depressions that act as vacuum cups, a metal pulley recently placed on the market uses the powerful force of suction to prevent a belt from slipping. As the belt rides around the pulley, it presses the air from each vacuum cup and the resulting air pressure gives it a firm grip. On leaving the pulley it automatically breaks the seal. According to the manufacturer, the device stops waste of power from slipping belts and increases the life of the belt.

ELECTRICITY RUNS NEW SWISS WATCH

A RETIRED watchmaker of Geneva, Switzerland, has just fulfilled his twelve-year ambition to perfect an electric watch. Driven by a fly-power motor, it needs no connection with outside wires. The case itself contains a storage battery no larger than the winding mechanism of most timepieces, which is declared to hold its charge for a year and which may be recharged when necessary. Electricity actually operates the watch and does not merely wind a spring as is the case in self-winding clocks. Plans have been announced to market the invention in Europe and America. Now the inventor, Georges Pellaton, is striving to construct an electric wrist watch, an ambition that calls for a radical rearrangement of the mechanism and a corresponding reduction in the size of the motor and the battery.

Georges Pellaton, Swiss watchmaker, exhibits his electric watch in which there are a motor and storage battery to keep it running



EXPLODING ALARM WARNS OF FIRE

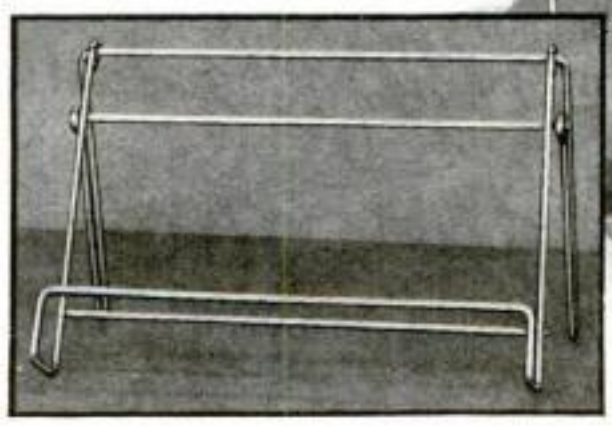
FIRES that start in the night automatically set off a new type of alarm, which consists of a short section of copper tubing, divided into two chambers and sealed at the ends. The chambers are filled with a mildly explosive composition. Heat from a fire explodes the mixture, blowing out each end of the tubing in succession with a loud report that will awaken a sleeper anywhere in the house. Photos at left show alarm before and after explosion.

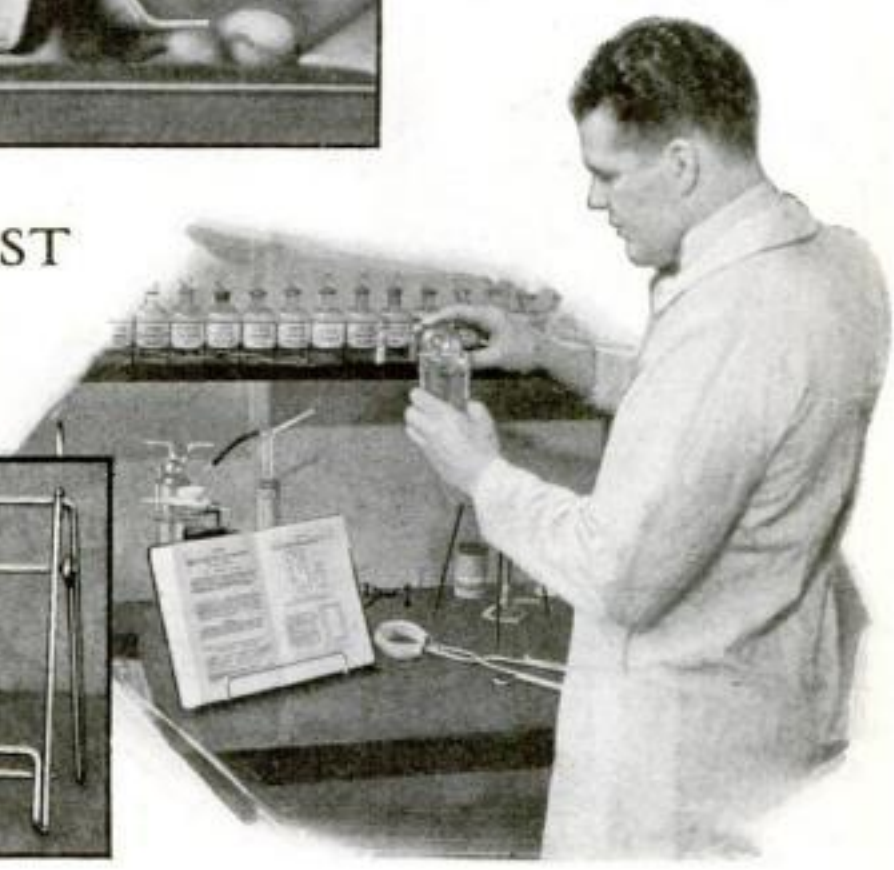
BOOK HOLDER AIDS HOME CHEMIST

TO GUARD a reference book from workshop stains or from possible damage by home laboratory chemicals, a convenient holder has been introduced. The book is opened to the desired place and slipped into a metal frame, where it is held out of harm's way and at such an angle that the worker may read it easily while he is standing. The book rest may be folded and slipped into a drawer when the day's work is through. It is so designed that books of any size may be placed in it.

The holder will also prove useful to ship model and other home shop workers.

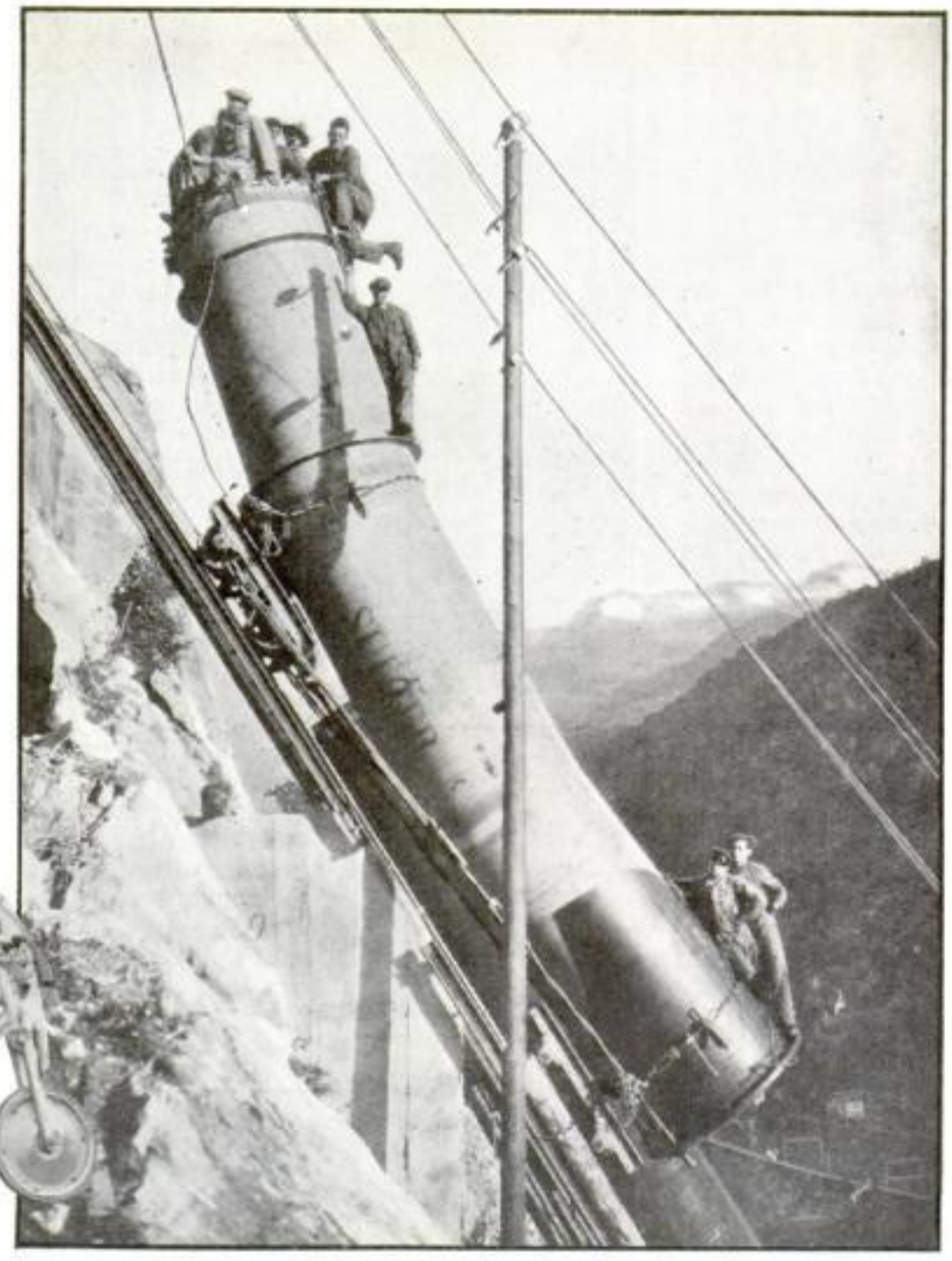
Convenience and neatness are served by this book rest which holds the volume so it can be read, but safe from damage





HAUL PIPE UP MOUNTAIN ON STEEPEST RAILWAY

To SOLVE the problem of building a pipe line for a huge new hydroelectric plant at the bottom of Monte Piottino, near Lavargo, Switzerland, engineers constructed one of the steepest railways in the world. Up this precipitous track, with a maximum grade of 165 percent, cables hauled the sections of a high-pressure pipe to bring water down from the mountain top. The remarkable photograph, right, shows a heavy "anchorage bend" making the ascent. Not everyone, perhaps, would care to take the place of the men who are riding it so nonchalantly, for the snapping of the cable would turn the car into a roller coaster of death.



Anchorage bend for pipe lines is hauled up world's steepest railway, which runs straight up the side of a Swiss mountain

SCOOTER HITS 40-MILE SPEED

A SCOOTER capable of running at more than a mile-a-minute clip has been built by John W. Greenwood, Oakland, Calif. The young inventor used a motorcycle engine, scooter wheels, a bike frame, and two fly sprayers as gas and oil tanks, in building it. The scooter is no vehicle for the timid, since it has no brakes, and is not provided with clutch or transmission. Greenwood never dared "open her clear up," contenting himself with forty-mile speed, but declares that it could attain a speed of seventy miles an hour.

John W. Greenwood, Oakland, Calif., exhibits his mile-a-minute scooter. A motorbike engine runs it

STEEL WALL KEEPS CARS ON VIADUCT

Installing the first section of a steel wall to keep cars on viaduct

WHEN a fourteen-inch steel curb was found inadequate to restrain skidding cars at a bend in a New York City motor viaduct, and several plunged over the edge to the street seventy-five feet below with fatal results, an unusual type of barrier was erected to prevent future accidents. A wall of steel three feet high was raised and bolted to the massive piers that support the whole viaduct, so as to become an integral part of the structure. The new guard will stop an overturned car rolling toward the brink, and even an Army tank would find it a formidable obstacle.

WATER FROM DEEP WELL BURNS WHEN LIGHTED

A CLEVELAND, Ohio, company recently drilled a 525-foot well to augment its water supply. When the turbine pump was placed in service, water came forth freely. Then someone carelessly tossed a lighted match in the direction of the supply nozzle. Immediately there was a fire. Examination revealed that the water is charged with minute globules of natural gas. Three or four months of pumping will be necessary to exhaust the gas.

Water from a 525-foot well at Cleveland, Ohio, took fire and burned at touch of lighted match

Sightseeing Bus *Runs Under Water*

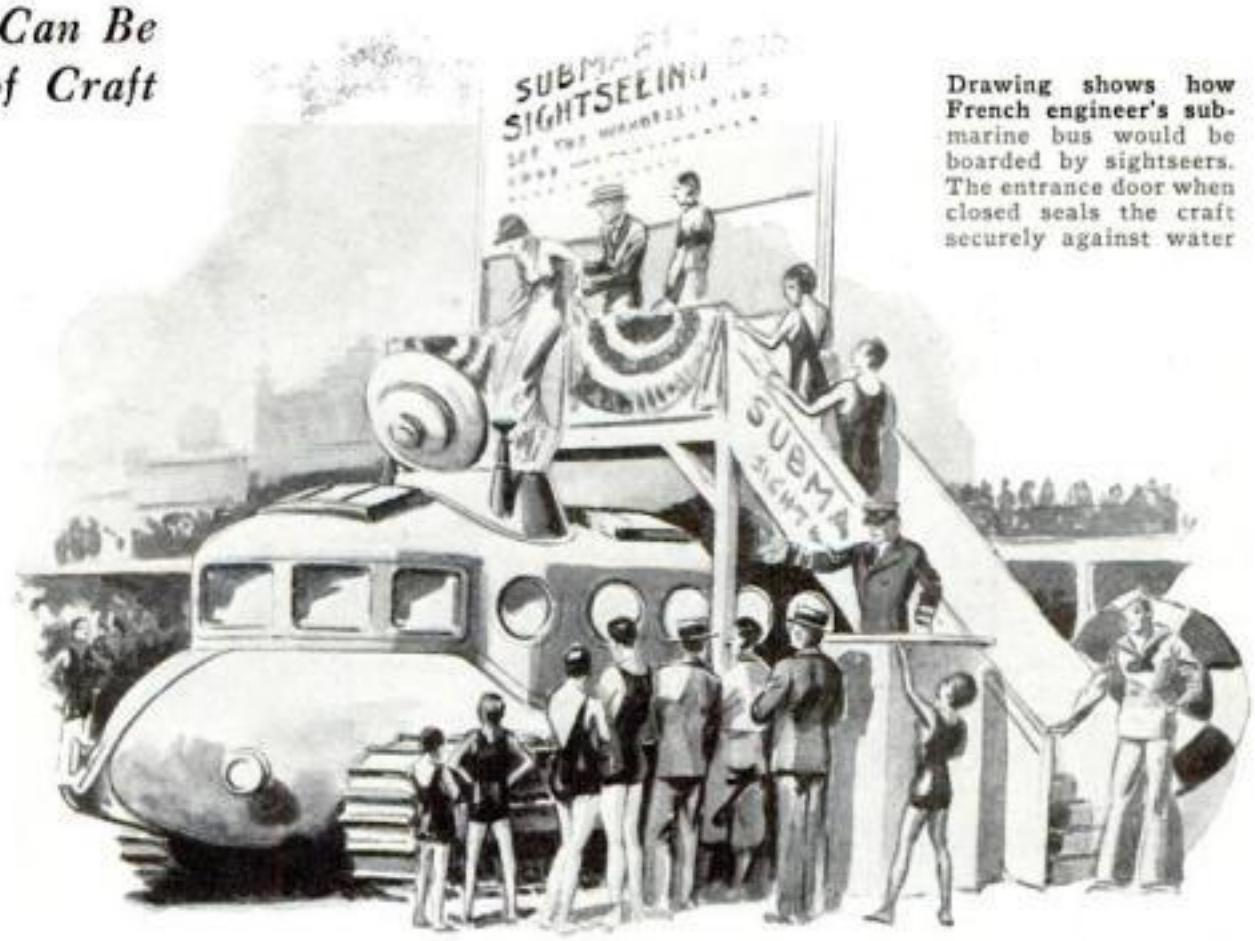
Marvels of Shallow Seas Can Be Viewed from Windows of Craft

YOU step through a hatchway and down a ladder, into the interior of a strange automobile. Other passengers file in and take their places in the comfortable seats beside you. The ladder is removed, and the hatchway door slammed shut and locked. With a hum of motors, the car, on endless tractor treads, lumbers down the beach toward the water.

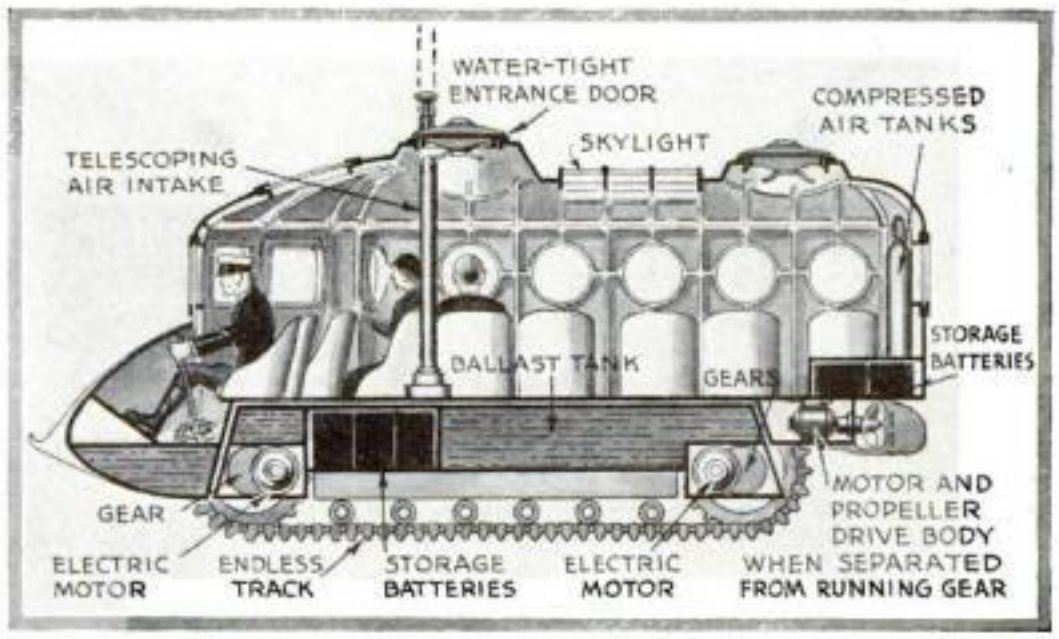
Suddenly there is a swishing noise. A greenish veil of sea water sweeps over the outside of the porthole window beside you. Past it glide forms of marine life. You are traveling on the floor of the sea!

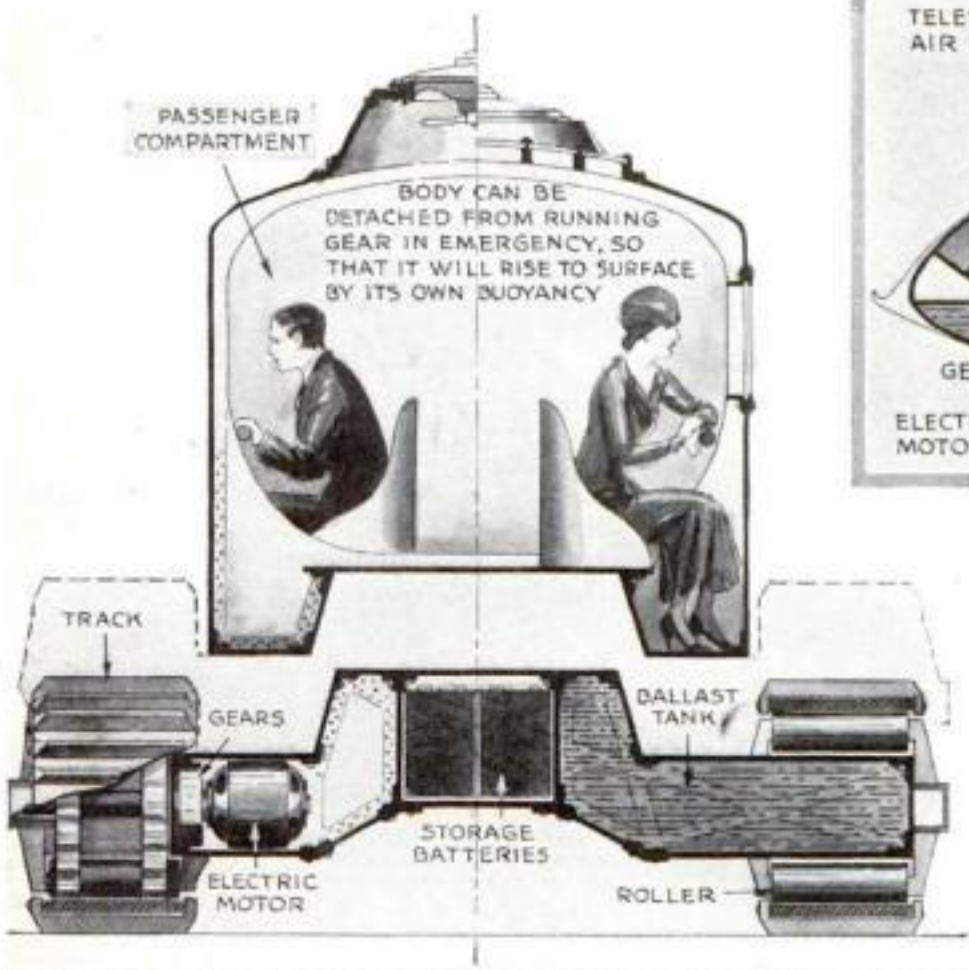
Sightseeing jaunts like this, beneath the waves along ocean beaches, are the amazing proposal of an engineer of Nice, France, who has worked out the design for such an electric submarine automobile. The accompanying sketches and diagrams, based upon his original drawings, show its construction. A vital safety provision is a detachable coupling between the passenger compartment and the undercarriage, so that the body may be released if the bus stalls while under water. The body would then float to the top of its own buoyancy, and proceed safely to shore under the power of an auxiliary motor.

The inventor is primarily interested in the possibilities of his vehicle as an amusement device, and foresees "submarine sightseeing buses" in operation at the larger watering places. He has also designed a more elaborate application of his idea—a submarine railroad in which a passenger car on flanged wheels would be pulled along a track laid under the sea.

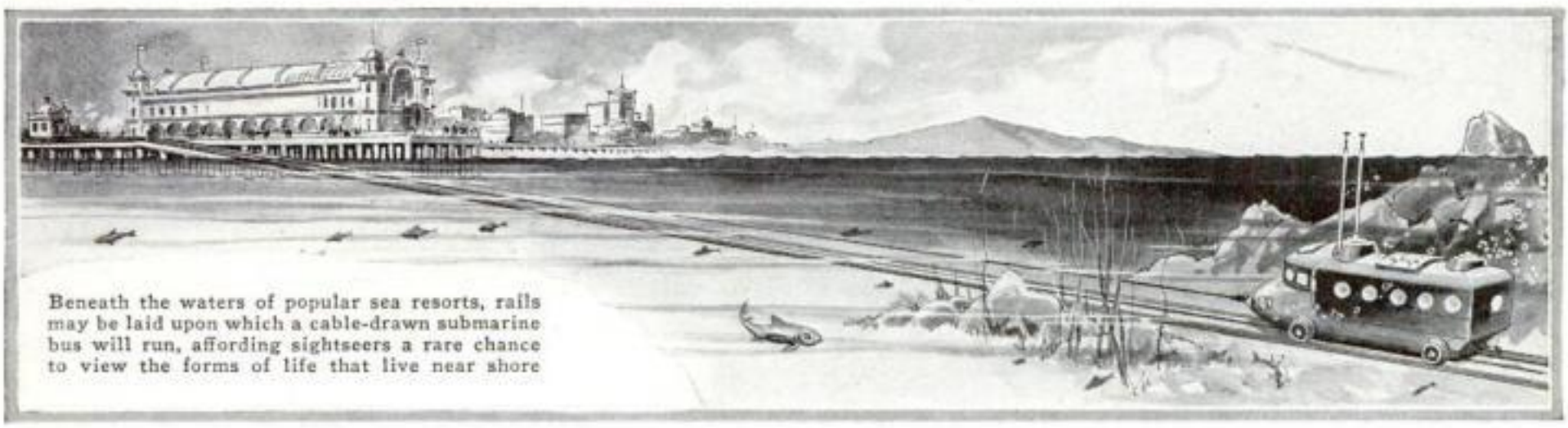


Drawing shows how French engineer's submarine bus would be boarded by sightseers. The entrance door when closed seals the craft securely against water

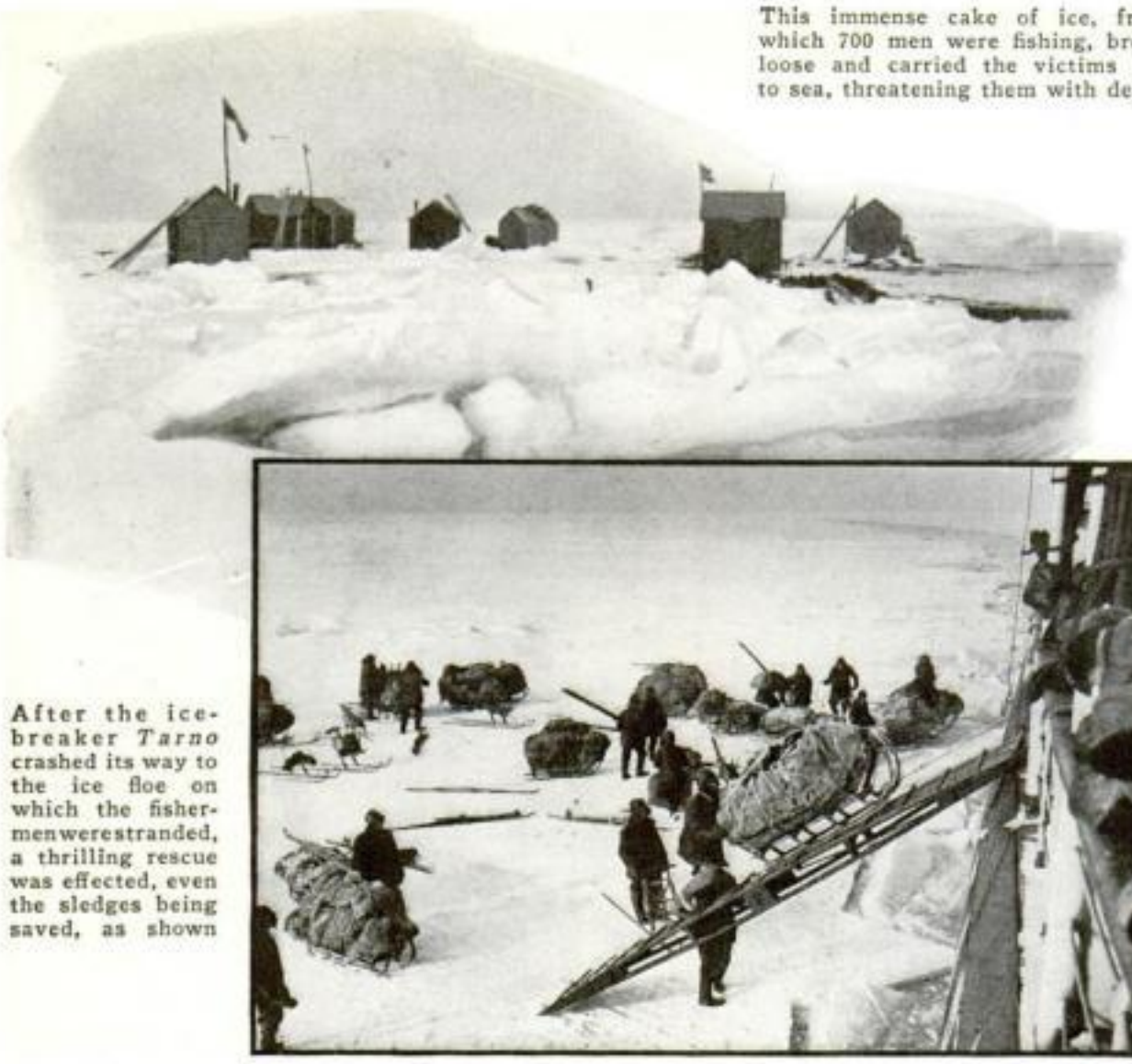




Drawing above gives clear idea of how the underwater bus will be constructed and operated. At left, diagram of interior of craft with passengers at portholes on both sides



Beneath the waters of popular sea resorts, rails may be laid upon which a cable-drawn submarine bus will run, affording sightseers a rare chance to view the forms of life that live near shore



This immense cake of ice, from which 700 men were fishing, broke loose and carried the victims out to sea, threatening them with death

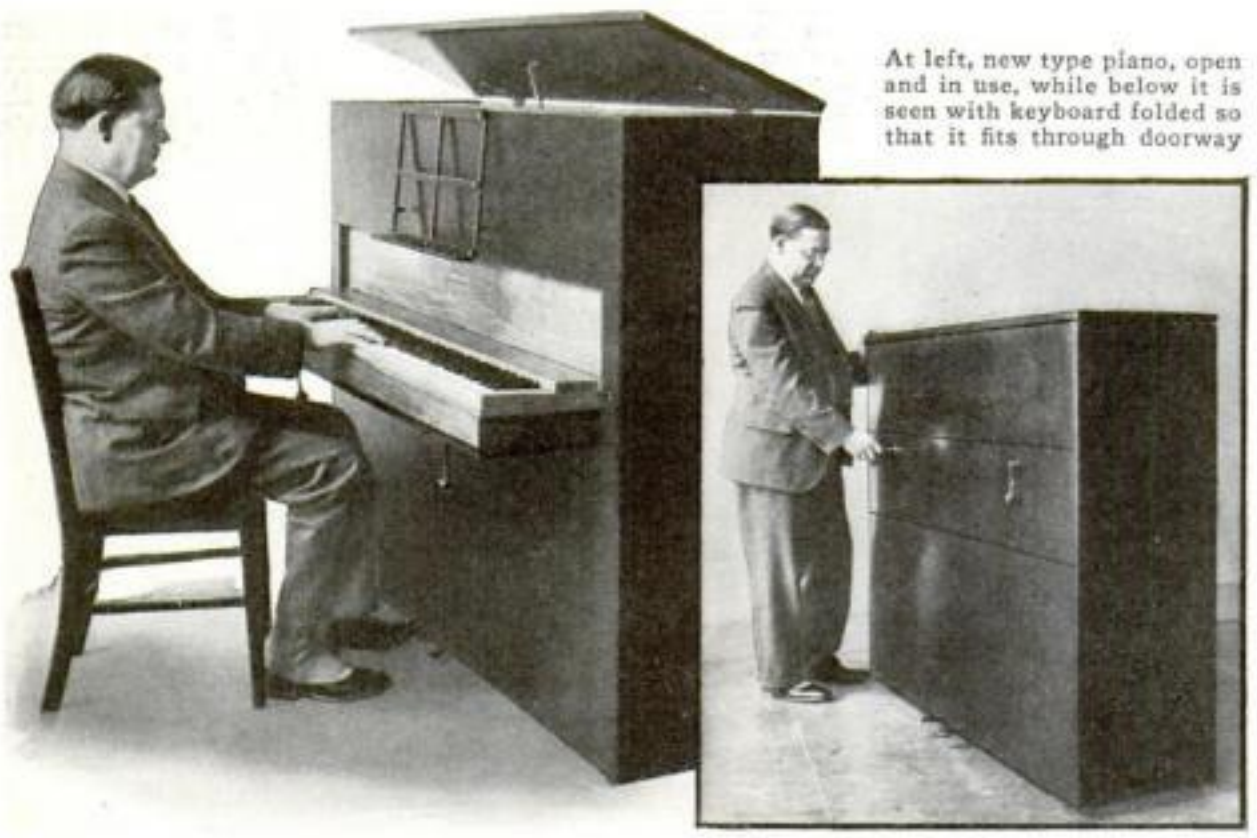
After the ice-breaker *Tarno* crashed its way to the ice floe on which the fishermen were stranded, a thrilling rescue was effected, even the sledges being saved, as shown

SAVE 700 ADRIFT ON BIG ICE CAKE

SEVEN hundred fishermen cast their lines, a few weeks ago, through holes chopped in the ice far off the shore of the Gulf of Finland. A storm arose. The ice cracked ominously. Deserting their temporary shelters, the panic-stricken fishermen dashed for the shore. They were too late—the floe had broken loose. They were marooned on an ice cake with their 100 horses, drifting out into the Gulf and in imminent peril of drowning, should the cake break up. To the rescue steamed the husky Finnish ice-breaker *Tarno*. Hours later its lookout, though half-blinded by a blizzard, sighted the unhappy castaways huddled on the ice cake. The vessel's armored prow crunched through the surrounding barrier of loose ice. The fishermen were helped aboard in one of the most thrilling rescues of modern times.

FOLDING PIANO FOR CITY APARTMENT

SO THAT a city apartment dweller may easily take his piano with him wherever he moves, a well-known manufacturer has introduced a radically new type of instrument. The keyboard and foot pedals fold into the case, and thus folded, the piano will pass through any door or narrow stairway, obviating the need of hoisting it through a dismantled window. Open, the piano has a full eighty-eight-note scale, and the manufacturer declares its tone equal to the conventional models.



At left, new type piano, open and in use, while below it is seen with keyboard folded so that it fits through doorway

STRAINED EYES TAUGHT TO WORK TOGETHER

FOR THOSE who have partially lost the sight of one eye by excessive strain, a new aid has been successfully tested in the optical research laboratory of the University of Southern California. Termed the "manuductor," this instrument outwardly resembles the old-fashioned stereoscope used for viewing pictures. In use, a patient gazes through the instrument at a pair of drawings. One is complete; the other lacks a few lines. By drawing in the missing parts, the patient relearns coördination between the two eyes.

MANY TINY SPRINKLERS SET IN NEW LAWN HOSE

A NEW style of garden hose needs no attachment to sprinkle the lawn. It carries its own tiny sprinklers, set into the side of the hose like tire valves at eight to ten-foot intervals. A separate metal support slips over the head of each one to hold it upright. Each sprinkler may be regulated.

PREVENTS SCARLET FEVER

MORE effective than the antitoxin now in general use is a new way to immunize children against scarlet fever, announced by the U. S. Public Health Service. It employs a mixture made of antitoxin and scarlet fever germs.

U. S. BUILDS FIRST PORTABLE METER TO MEASURE GRAVITY

BECAUSE the force of gravity varies slightly from place to place, a given weight does not weigh exactly the same in all parts of the United States. Exact determination of gravity's force is important in certain precise scientific work. For this research, experts of the U. S. Coast and Geodetic Survey announce that they have just perfected the first portable "gravity meter" ever built. It will take measurements anywhere that the truck which carries it can go. The oscillations of a pendulum in a vacuum within the instrument are recorded electrically by a photo-electric cell, and timed by radio signals from Arlington, Va.

First portable gravity finding meter, above, is being set up for field use, having been carried to the scene of operation in the truck, left, in which the radio outfit is operated to time the oscillation of a pendulum swinging in the meter case

ELECTRIC LIGHT PLUG CLAMPS FAST TO CORD

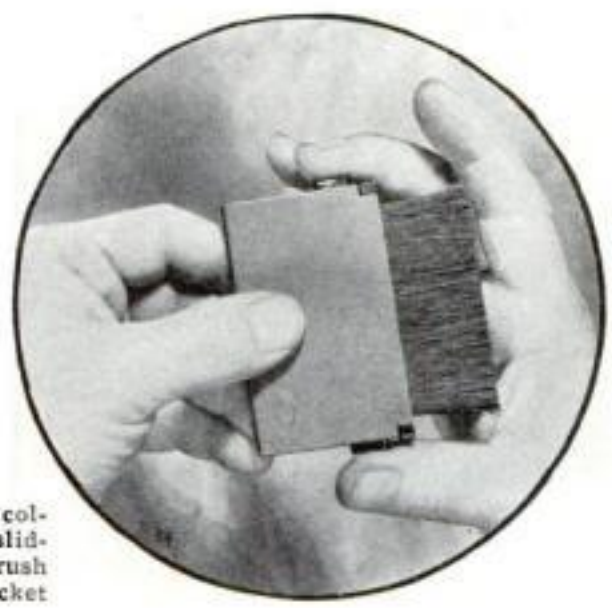
NO TOOLS but a knife to remove the insulation from the ends of the wires are needed to connect a new electric attachment plug to the end of a cord, for the device dispenses with the usual pair of brass screws that grasp the wire ends. Instead, the bare wire ends are inserted in slots at the heads of the sliding prongs. When the cap of the plug is screwed on, its milled edge squeezes the tops of the prongs. These in turn clamp down upon the wires with a viselike grip.

This new type of electric light plug, above, clamps wires with gripping jaws as shown in diagram at left

WOODEN FIGURES ARE OLDEST BEEHIVES

AMONG the strangest beehives in the world are the painted, wooden figures found in a small village in Silesia. The oldest is said to date back to the early years of the seventeenth century, when the property on which they stand belonged to a monastery. The latest were carved more than a hundred years ago. The bees go in and out through a hole in the head and there is also a detachable board in the front of each figure to permit the removal of honey the bees collect.

These wooden figures, some of them over three hundred years old, are beehives used in Silesia



Clothes brush, right, is collapsible, the bristles sliding into case so the brush fits easily in your pocket

FOLDING CLOTHES BRUSH FITS THE POCKET

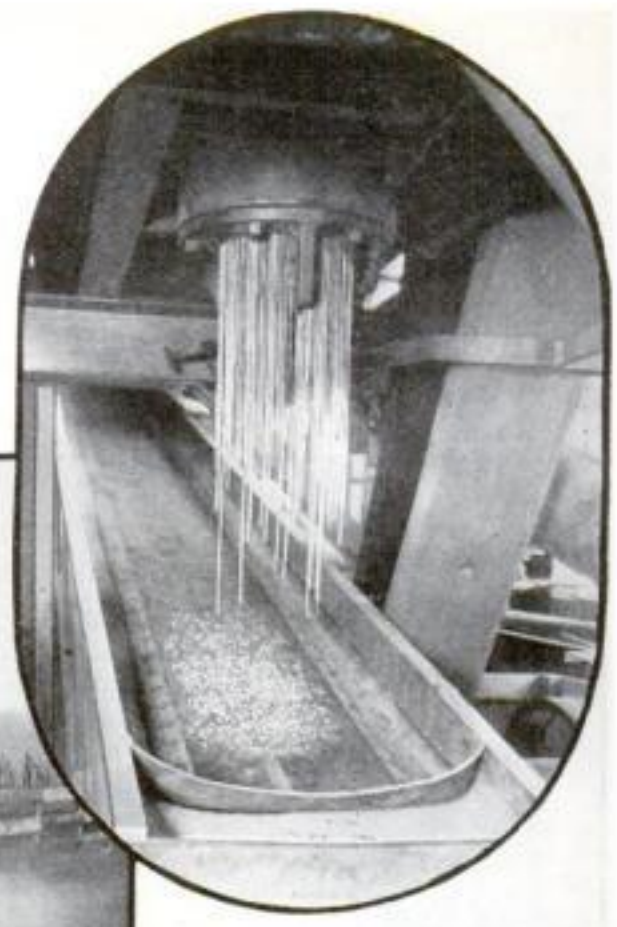
SO DIMINUTIVE that it may easily be carried in the pocket or in a woman's handbag is a clothes brush devised by a clever inventor who wanted one always at hand. When not in use, the bristles are protected within a composition case. They are brought into position for use by sliding out a pair of tabs at the ends of the brush, which run along slots in the case. With its aid a spot of dust on hat or coat may be flicked off in a jiffy. It is supplied in cases of several colors, and should prove handy in the equipment of a vacationist or a traveling man.

NEW "PILL" FERTILIZER IS POWERFUL

LITTLE gray "pills" of plant food resembling grains of smokeless powder, four times as powerful as ordinary commercial fertilizer, are science's newest contribution to farm relief. The new product, perfected by Theodore Swann, Anniston, Ala., chemist, has been tried out successfully for several months by colleges and experiment stations in this country.

Unlike concentrated fertilizers now on the market, it is dustless, noncaking, and as easily forced into the soil as grains of wheat. Growing plants may be given individual doses with the ordinary seed drill. By applying the grains well under the soil, five pounds per acre are said by the present experimenters to give as high a yield as 100 pounds of ordinary fertilizer strewn at random over the surface. The concentrated form of the fertilizer would greatly reduce transportation costs. Because of its dustlessness, little is blown away.

Swann expects it to be of particular service to the cotton grower of the South, who spends about one fifth of his income for fertilizer, and most of the experiments with the product have been in this section. Use of the new process has also been proposed in the projected manufacture of fertilizer at Muscle Shoals.

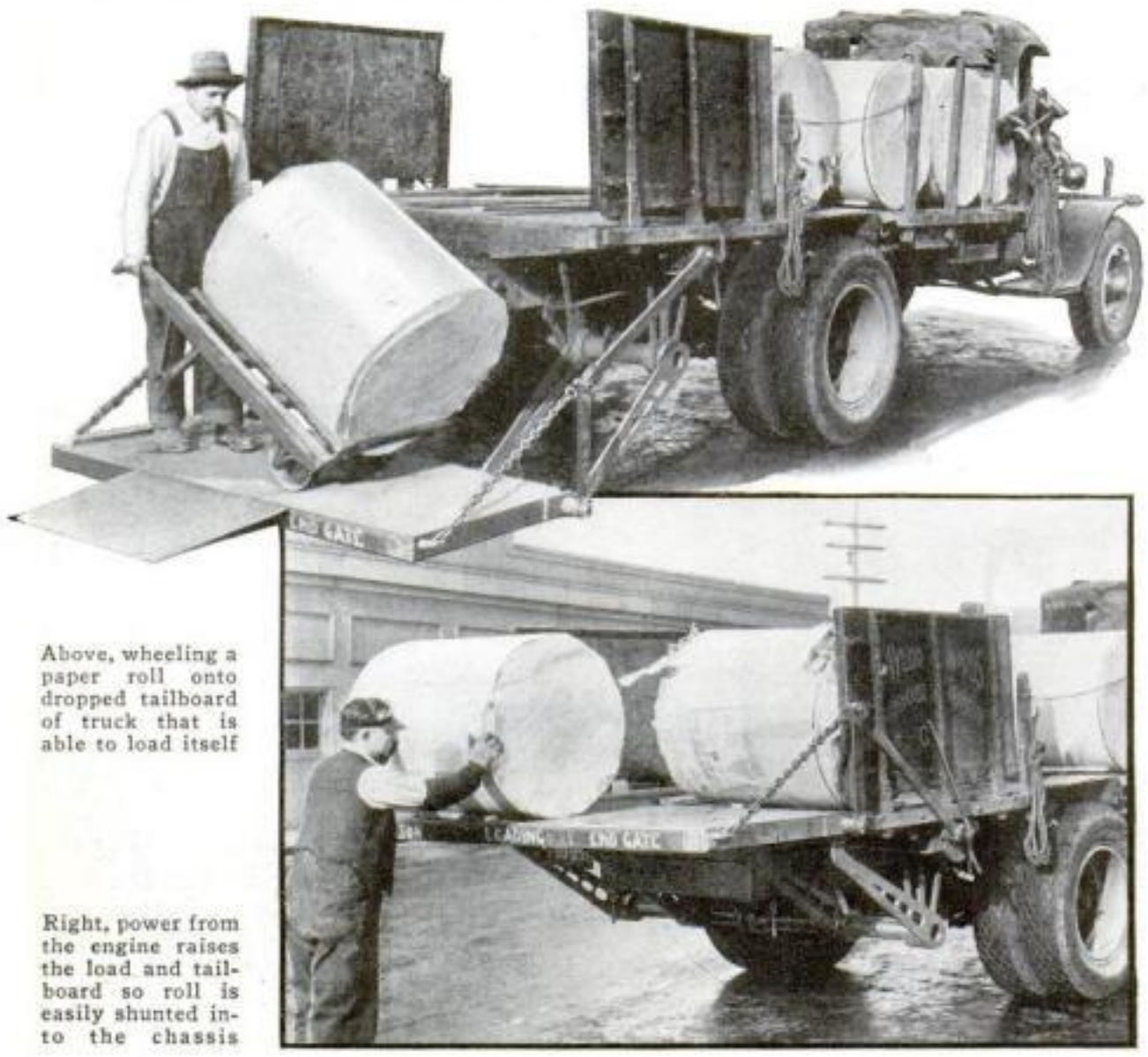


In manufacturing the new dustless fertilizer, above, it is forced out of mixing machine in spaghetti-like strings and cut off in one-eighth-inch pieces. At left, compare dustlessness of new fertilizer with old type being applied beside it

TRUCK LOADED WITH ITS OWN ENGINE

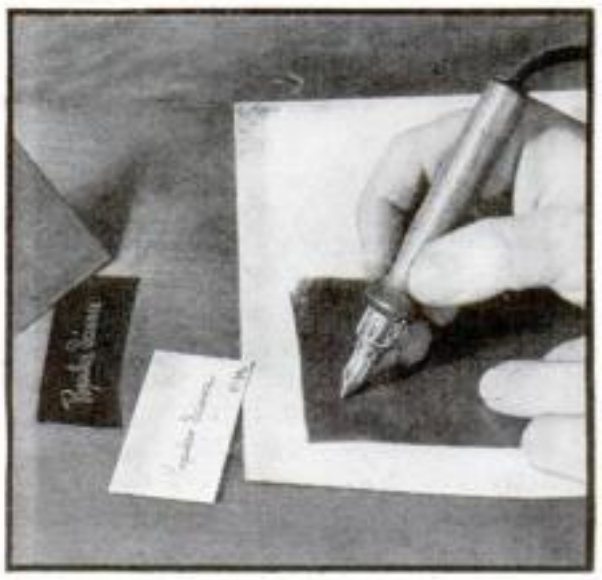
POWER from a truck's engine operates a new "loading end gate," saving time and labor in stowing heavy objects aboard the vehicle. The entire movement of the gate is under the driver's control by means of two levers. Power is transmitted from the truck engine through a standard transmission take-off and a hydraulic pump. The lifting mechanism is self-contained, so mounted as to relieve any undue stress on the chassis.

A heavy duty model, which is adaptable to large trucks, has a lifting capacity of 2,500 pounds. Its detachable apron enables heavy objects to be placed on it by means of hand trucks.



Above, wheeling a paper roll onto dropped tailboard of truck that is able to load itself

Right, power from the engine raises the load and tailboard so roll is easily shunted into the chassis

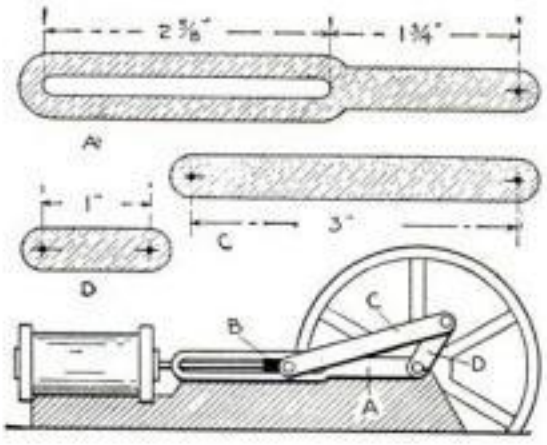


THIS "PENCIL" WRITES YOUR NAME IN GOLD

YOU can write your name in gold on paper, cardboard, or leather with a novel "electric pencil" that has been placed upon the market. Personal belongings such as hats, books, and gloves may thus be marked for identification. Among the many other uses suggested by the maker are the decorating of lamp shades and stationery, and the preparation of distinctively individual greeting cards.

For use, the "pencil" is plugged into a wall outlet. In a few moments, its styluslike point is hot and ready for writing. A sheet of special gold paper, supplied with the outfit, is placed over the object to be autographed, and the lettering is traced through with the hot point. On lifting the gold sheet, the letters are found permanently impressed in the object beneath the sheet. Silver and colored lettering may also be made with the use of suitable tracing sheets, increasing the range of the pencil for purposes of decoration.

I Can You Invent It?



THE mechanical members upon which the motion of the reciprocating steam engine depends are shown in the sketch at *A*, *B*, *C*, and *D*. *B* is a steel block sliding in the slot of *A*, actuated by the piston, and connected to *C*. *A* is the fixed member, while the three others are movable. By selecting *C* as the fixed member, with *A*, *B*, and *D* movable—or by making *D* fixed, with *A*, *C*, and *B* movable—entirely different mechanisms can be produced. Try to see how many mechanisms you can invent, using the identical linkage of parts shown in the reciprocating engine sketch. Also try to make one or more practical applications of each mechanism you discover. It will help your constructive imagination if you draw the parts to scale upon bristol board, cut them out, and connect them with pins so that their motions can be visualized more easily. It is not, however, necessary to keep the parts in exactly the relative lengths specified here. For example, the proportions of *A* to *D* may be changed, or the proportions of *C* to *D*, or *C* to *A*. Also, the position of the slot in *A* may be changed, and the steel block *B* may be imagined as pierced, surrounding and sliding upon *A*, instead of sliding in the slot of *A*.

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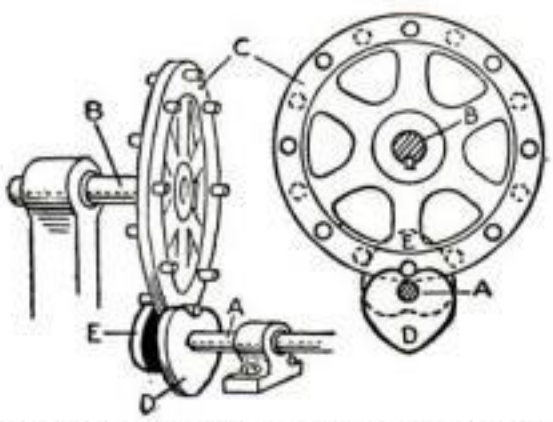
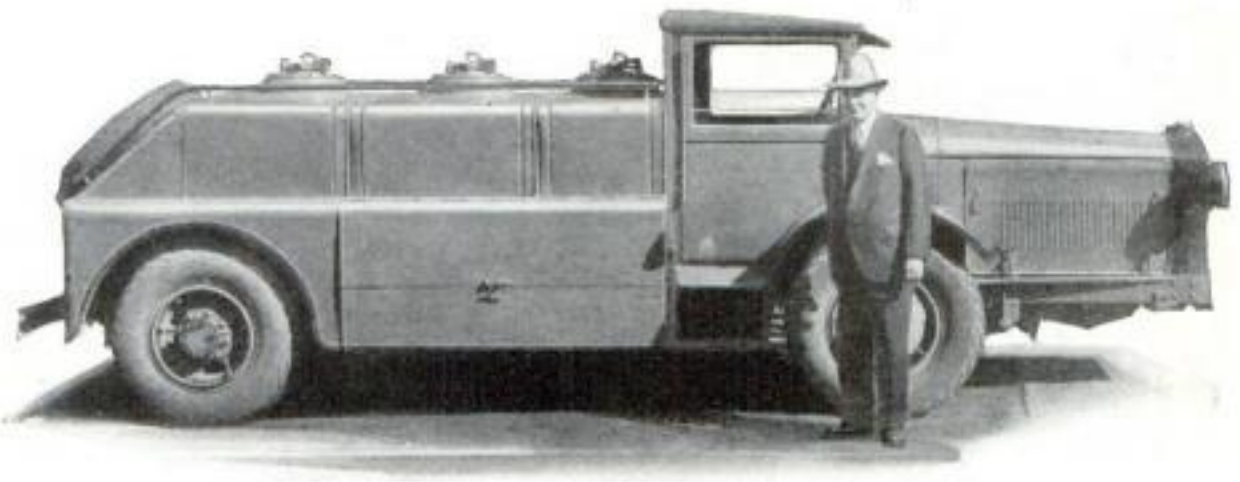
Below is the solution of last month's problem in transmitting motion from a shaft *A* to a shaft *B* by means of a wheel *C*.



Reduction in revolutions per minute is made by placing two-leaved pinion upon shaft *A*

FRAMELESS TRUCK HAS BIG CAPACITY



This space-saving truck has no chassis, the tank itself serving as the frame. The odd design raises the capacity of the machine to more than double that of the regulation truck

A LONG snout housing engine and radiator gives an odd appearance to a new style of front-wheel-drive truck for carrying gasoline and other liquids. This unusual vehicle has no chassis, the tank itself serving as a frame. Because of the width and depth thus gained, it holds 1,000 gallons, more than twice the usual quantity for a tank of this apparent size.

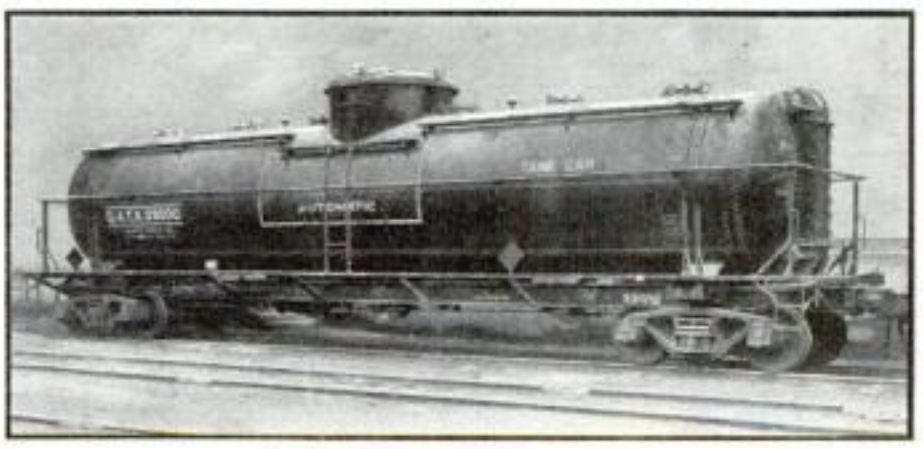
Foot-high toadstools, scattered about the lawn and lighted with hidden electric bulbs, contribute an original decorative effect

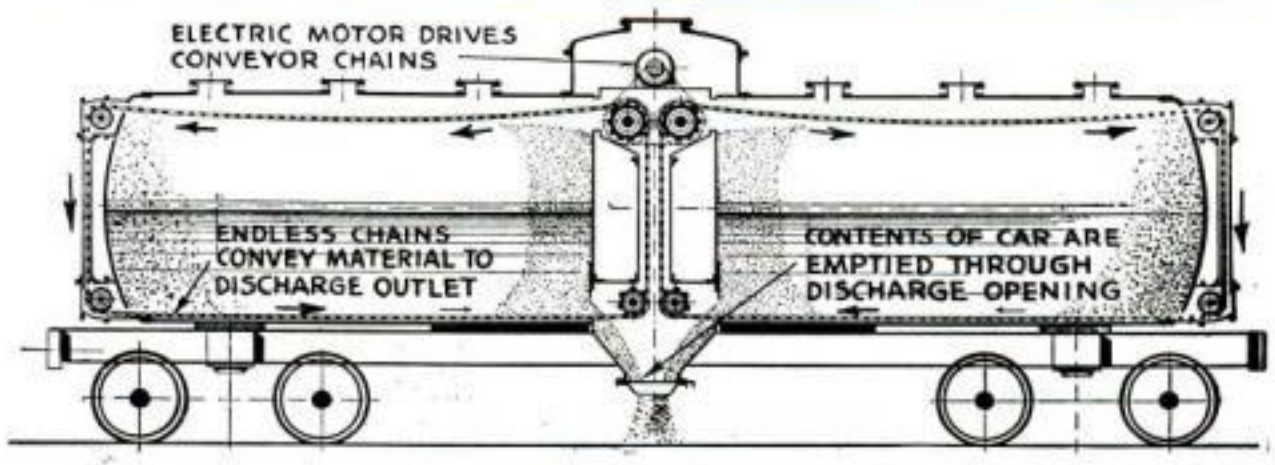
TOADSTOOLS ON LAWN HIDE LIGHT BULBS

AN ORIGINAL decorative effect for his lawn was conceived not long ago by a resident of Wauwatosa, Wis., who devised imitation toadstools illuminated by concealed electric light bulbs. At night the foot-high toadstools cast a pleasing radiance over the grounds. The scheme is a variation of floodlighting for estates.

NEW TANK CAR CARRIES DRY POWDER

CEMENT, flour, and other nonliquids may be transported in a newly invented type of railroad tank car, and poured like water from an outlet when it arrives at its destination. The secret of its operation is a pair of electrically driven conveyor belts within the tank, which force the powdery contents toward the opening in the manner shown in the diagram at bottom of this page. By the use of the new cars, containers such as barrels and bags are dispensed with, and handling charges are said to be reduced. Capacity is also considerably increased, as no space is wasted by separate containers. Use of the new tank car to transport commodities dangerous for humans to handle eliminates the hazard hitherto present.

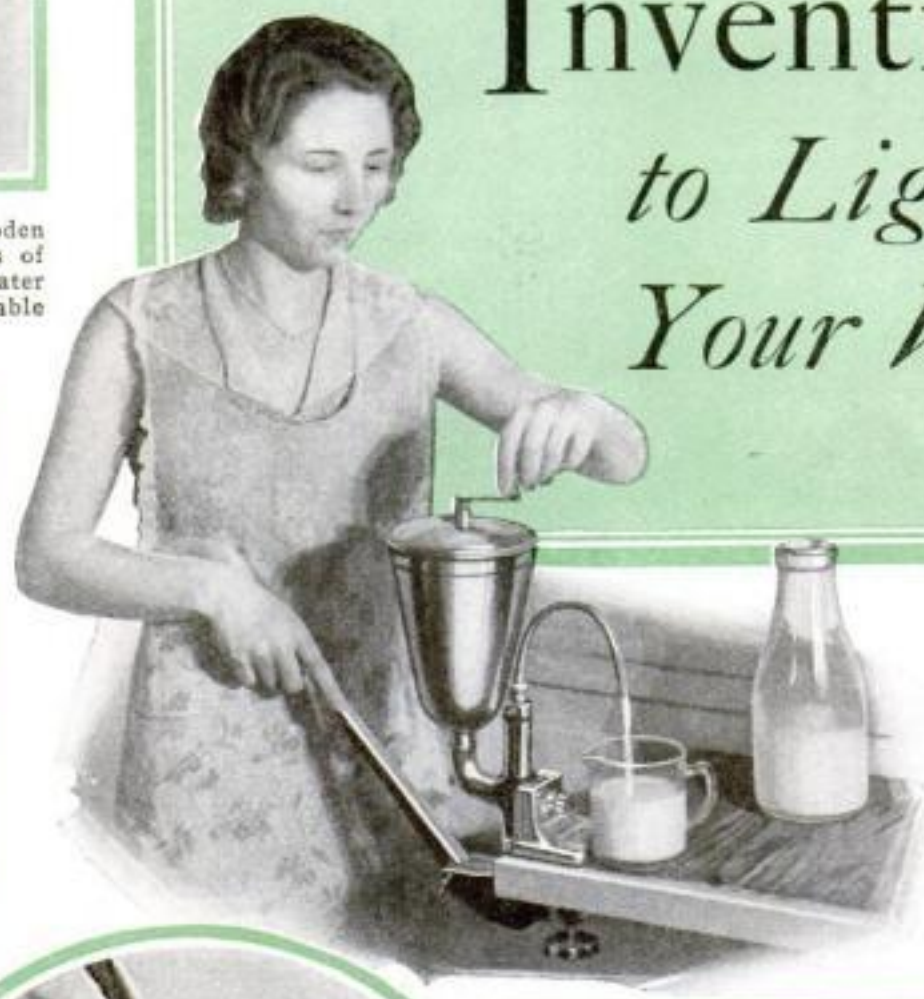




Photograph shows the new tank car that carries powders as the ordinary tank car handles liquids. The diagram reveals its operating mechanism and illustrates the means of unloading

Household Inventions *to Lighten Your Work*

BRUSH HOLDS SOAP. Between the wooden top and rubber sponge pad, small pieces of soap are inserted. Dipping the brush in water makes suds instantly. The pads are detachable



HOMEMADE CREAM. Unsalted butter and fresh milk, heated and mixed, are run through this machine once or twice, and the resulting mixture is fresh cream. Turning the crank operates a pump that mixes the ingredients under high pressure

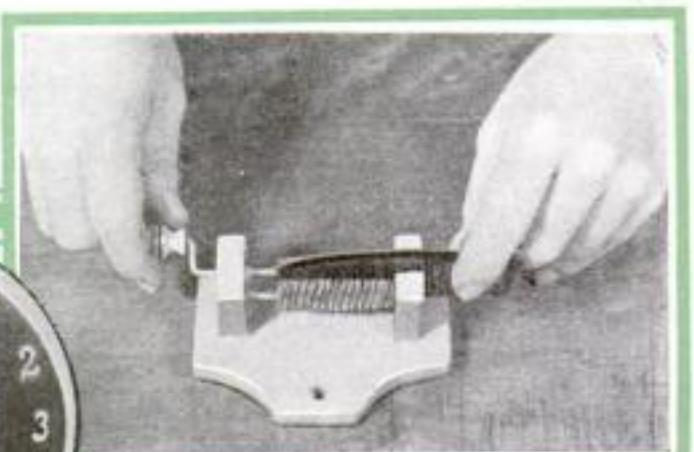
COOKS HOT DOGS. This electric cooker holds seven frankfurters. According to the maker, it shoots electric current directly through them, cooking them thoroughly in about a minute. Raising the handle turns on the switch

WINDOW IN SWEEPER. All the dust and dirt that accumulates in this carpet sweeper is plainly seen through its glass top. The housewife can thus see exactly how much refuse has gathered and dump the sweeper the instant it is full. Combs clean the brushes

COOKS DIFFERENT FOODS AT ONCE. A new breakfast skillet, two forms of which are shown above, is divided into parts to fry everything at one time

CRUSH THE ICE CUBES. Looking a little like a meat chopper, this new kitchen utensil is designed to crush ice cubes from an electric refrigerator so that fruit and other food can be more thoroughly chilled with the finely broken ice crystals. The cubes, dropped into the hopper, are fed automatically to the crushing picks

FRYING PAN CLOCK. When working in the kitchen the time of day is easily learned from a clock set in the bottom of a frying pan with a knife and fork for the hands. The clock keeps good time



COMB CLEANER. This simple little contrivance for the dressing room has a groove into which a comb fits. A turn of the handle sweeps bristles through the comb to clean it

NOZZLE FOR FOOD CONTAINERS. Any package that holds cereal, soap powder, or sugar can be fitted with an economy nozzle that controls the amount poured out when the box is tipped up. It is removable and quickly attached to the container

DRY CLEANING AT HOME. A new washer-like machine will clean fabrics with a dry cleaning fluid into which it is not necessary to place the hands. The machine is laid on its side while the crank is turned for cleaning and then stood upright so fluid drains away and the garments dry quickly

REEL WINDS UP LIGHT CORD. Fitted into the base of this lamp is a reel that automatically winds up any slack in the lamp's cord, thus avoiding accidents caused by tripping over the loose cord

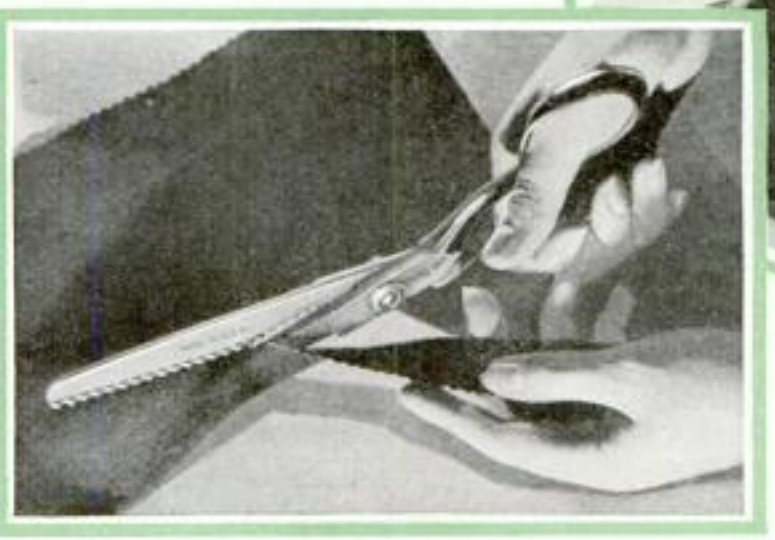
CRACKS YOUR EGGS. A device breaks an egg by cracking the shell when two handles are pulled back. The opening jaws then permit the egg's content to fall through

OIL BURNER FOR STOVE. This attachment for the kitchen range burns crude oil with compressed air, thus providing heat that is clean and cheap. It was shown recently at an English fair

JUICE EXTRACTOR. An orange or lemon juice extractor hangs on the wall and is operated by turning a crank on the bottom. It also strains the juice and comes apart easily for cleaning

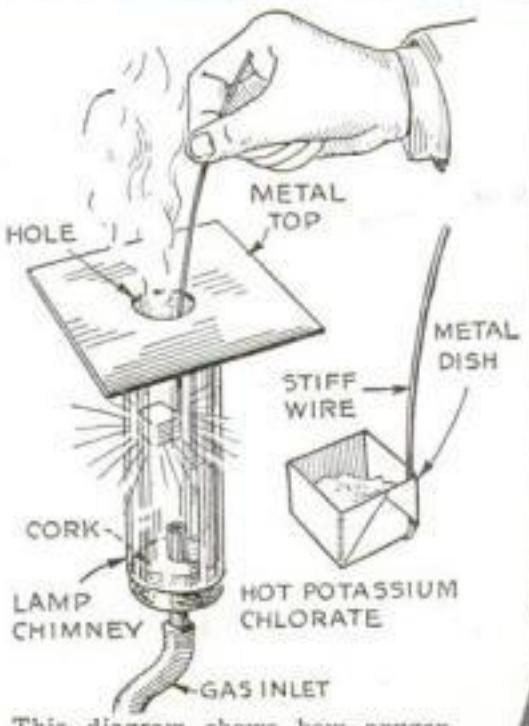
TIE PRESSER. A frame of spring wire, shaped like a necktie, is slipped inside the tie, after which the tie is dampened at the wrinkled places. The presser is then left lying on dresser overnight and in the morning, when the wire is removed, the tie is free of wrinkles

PINK WHILE YOU CUT. Material is cut and pinked at the same time with the scissors shown below. Zigzag teeth give the pinking effect while edge cuts any material



POINTER FOR THE DIAL PHONE. The use of the finger or a pencil in dialing a number is unnecessary when the pointer shown above is attached to the dial plate. The knob is easily moved from letter to letter, saving time

EXPERIMENTS



This diagram shows how oxygen, escaping from potassium chlorate and manganese dioxide, can be burned in ordinary illuminating gas

1. To mend a broken test tube, heat the end in a Bunsen burner until it is soft enough to manipulate

2. With blunt nosed forceps press the broken sides of the tube together and pinch off the surplus glass below the point of fusion

3. Reheat the repaired end of the test tube and then blow gently into its mouth. In this way the tube is given a rounded end

Three Steps in Mending a Broken Test Tube

By Raymond B. Wailes

EXPERIMENTS with oxygen will give you more pleasure than any other operation in your chemical laboratory. It is surprising what exciting moments you can have with a few cents worth of potassium chlorate, the cheapest substance with which oxygen can be made.

Oxygen is produced quite easily if equal parts by volume of manganese dioxide and potassium chlorate are heated in a test tube fitted with a one-hole cork carrying a bent glass tube. The end of the tube should be attached to a curved glass medicine dropper by means of a short length of rubber tubing. This will provide a delivery means for the oxygen gas. As a collective means, fill a test tube with water, close the mouth with the hand, and invert the tube under a beaker of water and remove the hand. Water now completely fills the tube. Heat the oxygen generating tube for a few seconds to allow the air inside to escape through the medicine dropper. When oxygen gas begins to issue from the dropper place it under the mouth of the inverted collecting tube. The oxygen bubbling up forces the water out of the tube into the large beaker. When the tube is full close its mouth, remove it, and set in upright position.

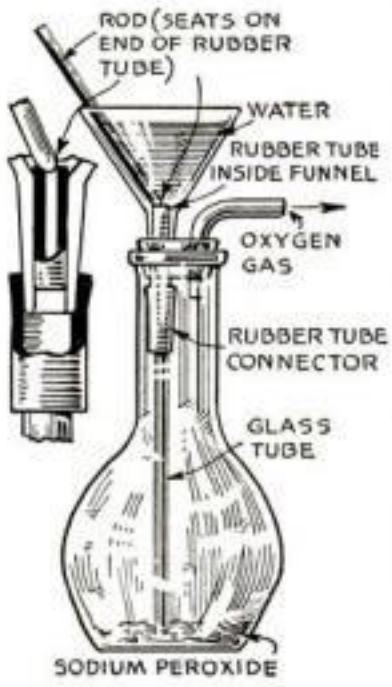
Several jars of oxygen can be collected in this manner from the same charge of potassium chlorate and manganese dioxide. An inverted and water-filled collecting test tube can be held upright by means of three spring clothespins clamped to a little stand. Small supports, or ringstands, can be purchased from dealers in chemical supplies.

A glowing length of punk, string, or wood, if placed in a tube of oxygen, will burst into flame, often with a harmless little explosion. Sulphur will burn in oxygen as can be seen by heating a little until it takes fire, then inserting it in a jar of oxygen. The sulphur unites with the oxygen, forming sulphur dioxide gas. If after the experiment several drops of water are twirled about in the bottle, the gas will dissolve in the water, to form weak sulphurous acid.

Red-hot charcoal dropped into a bottle of oxygen will flare up and burn brilliantly. In performing this experiment care should be taken against flying sparks.

When no more oxygen can be produced from the potassium chlorate manganese dioxide mixture, let the tube cool and dissolve the contents in water. The white residue is impure potassium chloride, and will dissolve in the water. The black manganese dioxide can be filtered off by pouring through a folded filter paper placed in a funnel. Afterwards it can be washed with water, dried, and used again with fresh potassium chlorate in making more oxygen. It will never become "used up," for like a true catalyzer, it is not changed when heated with the chlorate.

Chemists who have no gas with which to heat the potassium chlorate mixture can use an alcohol lamp. However, oxygen can be made without heat by allowing water to drop onto sodium peroxide. To produce a steady stream of oxygen in this manner, a short length of rubber tubing is inserted in the stem of a funnel which rests in a flask containing sodium peroxide. A rod of glass is placed in the rubber tube and the funnel filled with water. By manipulating the rod, water can be allowed to enter the flask a drop at a time. As the water strikes the sodium peroxide a steady stream of oxygen gas will flow from the bent glass outlet tube. A length of glass tubing, attached to the lower end of the funnel, will prevent the oxygen gas from escaping through the funnel. Although this method is expensive, it is convenient. The sodium peroxide should be kept in a tightly stoppered container.



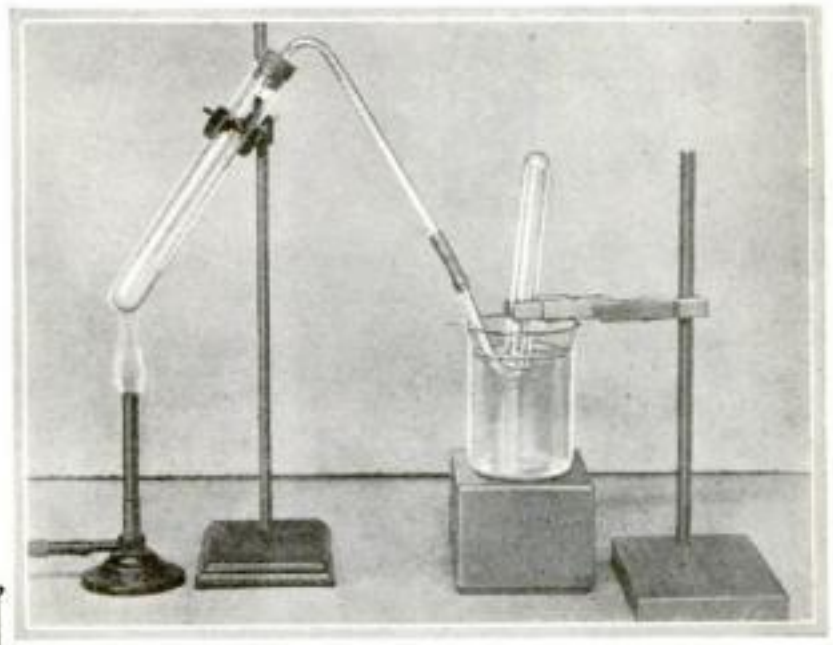
By using the apparatus shown here, oxygen can be obtained without the use of heat. Water is released from the funnel and oxygen is liberated when it strikes sodium peroxide in the bottom of the flask

Experimenters who lack a gas supply on their workbenches can heat small quantities of solutions over an inexpensive electric cigarette lighter unit which plugs in to the house current and can be operated at slight cost. Heating a beaker or test tube by this method presents no trouble, as the photos show. The beaker rests upon a square of iron wire screen, or gauze, supported by L-hooks screwed into a block of wood. For heating larger flasks by electricity, a one-burner electric stove can be used. There is little danger of breaking glass containers when heated in this manner if they do not touch the red-hot wires.

Test tubes break easily, but if a Bunsen burner is available, they can be

with OXYGEN FOR THE HOME LABORATORY

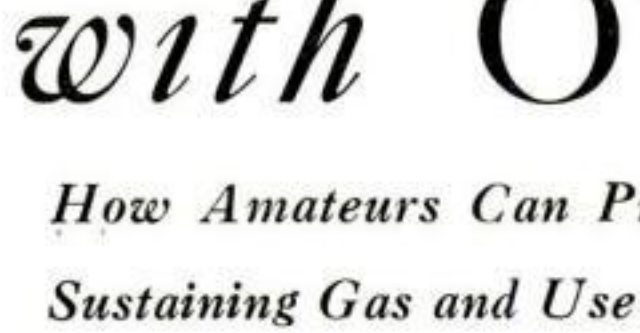
How Amateurs Can Produce Life-Sustaining Gas and Use It in Thrilling and Fascinating Demonstrations



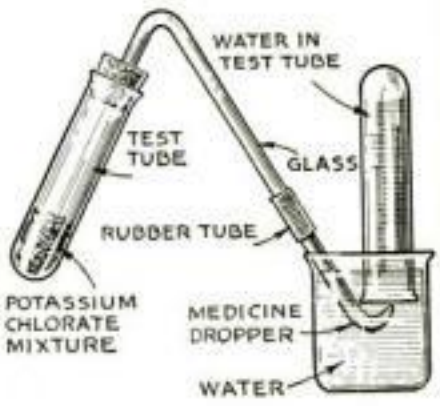
OXYGEN FLOWS from heated chlorate mixture and is led through medicine dropper to inverted test tube supported in water. When test tube is full it is closed and gas is saved

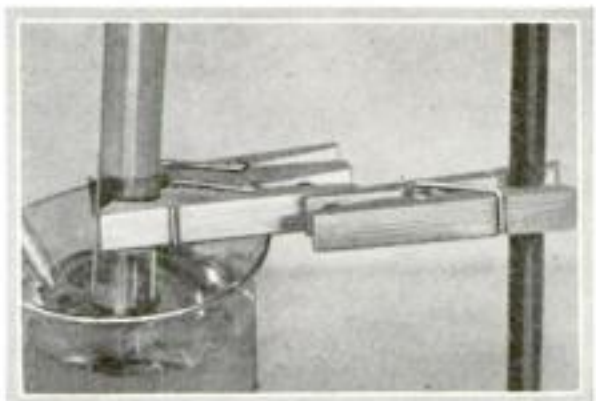
mended. First, heat the broken end until soft, then press the sides together with forceps and pull off, the surplus glass thus closing the tube. Reheat the mended tube and blow gently into it to round out the lower end. Care should be taken to see that the blown end is no thicker than the walls of the tube. Sooting the tube in a yellow gas or candle flame and then cooling it, will give a tube that can be used to advantage in the laboratory. An alcohol lamp will not produce the temperature needed in making a repair of this type. Broken test tubes, if too short, cannot be mended in this manner. Short lengths of broken tubes are useful for various purposes in the home laboratory and should be saved. Cut the uneven edge off (P.S.M., Feb. '32, p. 69) and flare the end with a warm pointed battery carbon gently rotated inside the tube while it is being heated in a Bunsen flame.

A rather spectacular experiment that will give you some new ideas about burning oxygen can be performed with illuminating gas and a glass lamp chimney. The bottom of the chimney is fitted with a stopper through which gas is led by means of a tube. The top of the chimney is

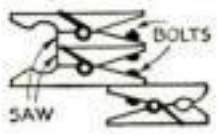


After cutting off the uneven edge of a broken test tube, flare end as shown above





SPRING CLOTHESPINS clamped to the upright of a supporting stand will hold test tube over beaker



covered with a sheet of metal having an inch hole in its center. The gas issuing from this hole can be lighted and will burn. A long handled dish containing potassium chlorate and manganese dioxide is heated until the chlorate melts and oxygen gas is liberated. The dish is then thrust through the hole into the illuminating gas within the chimney.

Usually the flame at the top will be extinguished, but the oxygen given off by the chlorate will burn with a brilliant bluish-white flame, which will last as long as the oxygen continues to come off, the combustion producing sufficient heat to maintain the flow of oxygen. Burning oxygen in gas in this manner is known as reciprocal combustion. The long handled dish can be made by folding up a square of metal to form a pan, the wire handle used for lowering it into the chimney being fastened to the pan by crimping the turned-over sides upon it.

Manganese dioxide contains oxygen which can be obtained from it by heating in the presence of strong sulphuric acid. Red lead, sold in paint stores, also yields oxygen when heated with sulphuric acid.

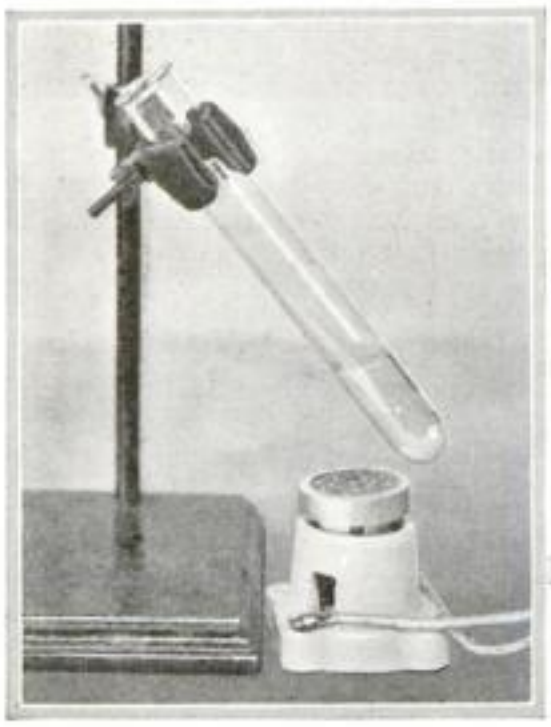
The experimenter should not entertain the idea that substances containing oxygen always need to be heated or acted upon by strong acids to produce oxygen. Potassium permanganate, a relatively inexpensive chemical which can be bought at almost any drug store, parts with its oxygen quite readily.

Last month (P.S.M., May '32, p. 68) the method of obtaining hydrogen by the electrolysis of water was explained. Oxygen was produced by this experiment. If plenty of direct current is available, this way of storing up a supply of oxygen for various tests is excellent. Large bottles can be used in place of the test tubes for collecting the gas.

Large quantities of oxygen are prepared and sold commercially. One important use is in welding torches. Oxygen tanks form the equipment of every hospital for the treatment of pneumonia patients and for other emergency uses.

Oxygen for commercial purposes now is made chiefly from liquid air, which consists of a mixture of the various gases that make up air, the principal constituents being liquid oxygen and liquid nitrogen. These two liquids have different boiling points—oxygen boils at -182.5°, whereas liquid nitrogen has a much lower boiling point, -194 degrees. When liquid air is allowed to boil slowly away, the liquid nitrogen, having the lowest boiling point, goes off first; and after the process has continued for a time, the remaining liquid is nearly all oxygen. This process of isolating oxygen is, of course, beyond the equipment of the ordinary home laboratory, which will have no means of liquefying air. Anyone who has a real interest in chemistry, though, will want to know the commercial methods of producing the substances which he manufactures on an experimental scale.

Cigarette Lighter Furnishes Heat



At left, a cigarette lighter plugged into the house current supplies heat for chemical experiments when a test tube holds the solution. Below, a wire mesh on top of lighter supports a beaker

RADIO *on Shore* *Runs* Model Yacht

Signals Steer Seven-Foot Craft on First Voyage and Dock It Safely

David Bammes, at left, one of the builders of the model yacht, is sending the radio signals that guided craft across lake

Above, the yacht *Alita* under way on a California lake, controlled by radio. At left, Homer Howard, one of the two builders of the boat, is placing the receiver in the model yacht. It was by means of this that the *Alita* was sailed and brought back to its dock without mishap

A TRIM brigantine rigged model yacht recently tacked back and forth across a lake at Pomona, Calif., and finally swung smartly into the wind for a clean landing at a model dock.

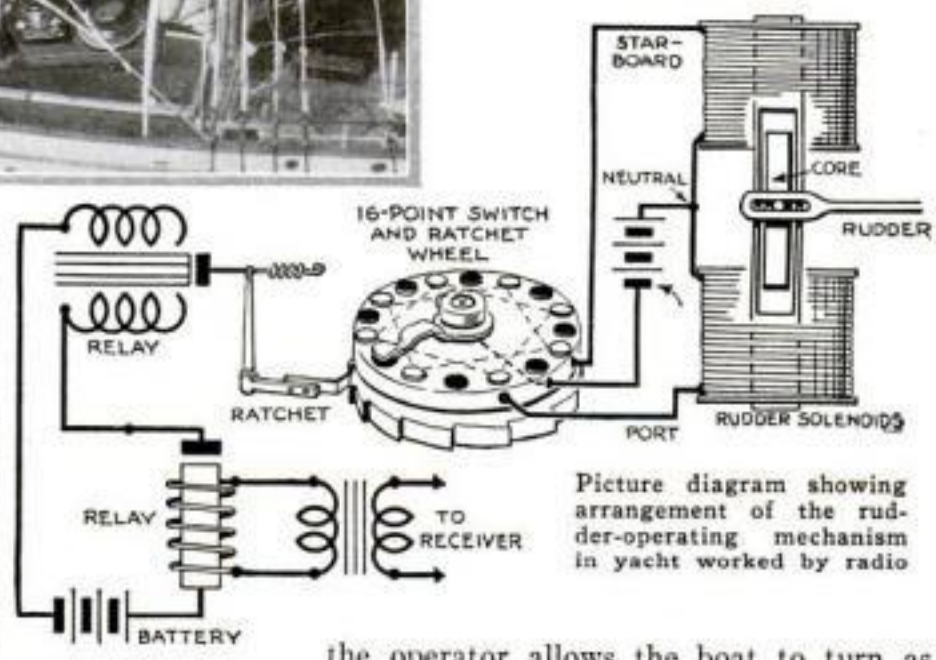
The helmsman of this seven-and-one-half-foot miniature sailing craft was some distance away on the shore of the lake. A radio transmitting key was the link between his hand and the steering mechanism of the boat, the latter being remotely controlled by impulses from a small amateur radio transmitter.

The radio-controlled model yacht *Alita* was built by two boys, David Bammes and Homer Howard, members of the Pomona Model Yacht Club, under the direction of Herman Howard, sponsor of the club.

As the photographs show, the *Alita* is a fine job of model building. Having a beam of fourteen inches and also a fourteen-inch draft, she has ample "cargo" capacity to take care of the weight of the three-tube battery operated radio receiving set and the radio-controlled rudder mechanism.

Both the transmitter on shore and the receiver in the yacht follow conventional amateur radio practice. A sensitive, high-resistance relay takes the place of the usual headphones in the receiving circuit. When this relay closes in response to a radio signal, it allows current to operate a magnet which moves the pawl of a circular-disk ratchet switch. The contacts on this switch close the circuit to a double solenoid, the armature of which is attached to the end of the tiller. Every other contact is "neutral," and the remaining contacts alternately throw the rudder to starboard and port.

Assuming that the switch is resting on a neutral contact, the boat will sail straight ahead till the helmsman on shore sends a dash. This will throw the rudder to one side or the other, depending on which operating contact comes next on the ratchet disk switch. If the contact happens to throw the rudder in the right direction, the operator allows the boat to turn as far as desired and then sends another dash to return the switch to the neutral position. If the rudder is turned in the wrong direction, two dashes sent in quick succession immediately turn the rudder to the position desired.



Picture diagram showing arrangement of the rudder-operating mechanism in yacht worked by radio

Herman Howard, sponsor of the Pomona, Calif., model yacht club, with the radio-controlled craft

The picture diagram shows the arrangement of the rudder-operating mechanism. It would, of course, not be practical to apply radio control to a model boat of smaller size because of the weight of batteries necessary to operate the radio receiving circuit and the relays.

The home construction of the parts that operate the rudder when signals are received by the set on the boat should present no difficulty to the radio and electrical experimenter. The transformer connected between the radio receiver and the first relay should be of the step-down type such as is used to couple the plate circuit of a power tube to the voice coil of a dynamic speaker. The first relay will then operate on low voltage current. This method is satisfactory if the transmitting wave is interrupted at relatively low frequency.

Where Crystal Sets
STILL DO THE TRICK

TUBELESS, batteryless, crystal radio receivers still have a sphere of usefulness. Judged by modern standards, the most satisfactory type of crystal radio circuit, shown in Fig. 1, is extremely insensitive and tunes as broad as a barn door. It won't work a loudspeaker and if you get a station more than twenty-five miles away it's just a lucky break.

However, there are hundreds of powerful broadcast stations scattered over the country and consequently many thousands of people live almost within sight of one of them.

Under such conditions it is possible to obtain hours of entertainment at almost no cost. Furthermore the tone quality produced by a crystal set equals that of the latest modern broadcast receiver if you don't mind the inconvenience of wearing headphones.

Carborundum, silicon, or galena can be used for the crystal. One contact with the crystal can be made by winding tightly with several turns of bare copper wire. The other contact, for either silicon or galena, should be a piece of fine spring wire called the "cat whisker," so held that you can "explore" the surface for a sensitive spot. A light contact works best. Carborundum requires a movable contact more substantial, so that the point of the contact can be held against the crystal with a pressure up to five pounds.

For those who wish to build a crystal receiver at the absolute minimum of expense, it will be necessary to purchase only a pair of headphones and one quarter pound of No. 22 insulated wire. Condensers *C* and *D* can be made from tin foil in which tea is packed. Each condenser should consist of two pieces of tin foil two inches square separated by a layer of writing paper. The sheets of tin foil can be held in contact with the paper by placing them between two pieces of wood with a rubber band to supply the tension.

With such construction *C* will be fixed and not adjustable, so it will be necessary to tune by adjusting the number of turns in coil *B*. This can be done by lashing the bare end of wire *Y* to a needle and poking it through the insulation on various turns till you find the one that gives the best response. Then cut the coil at that point and make a permanent connection. This is a satisfactory arrangement when you want only one local station.

Fig. 2. Short wave coil forms and sockets of isolantite that is a good insulator. Note holes to fit any length of winding

New Plug-in Coils

HERE is a new idea in short wave plug-in coil forms. Photo at upper right shows these parts for the radio experimenter made of a ceramic known as isolantite. This material looks like common porcelain but is far superior to it for electrical work. It is, in fact, one of the best insulators known for use at radio frequencies.

The sockets, of either the four- or five-hole type, are simple in design. A plain, flat plate of isolantite is made with the necessary holes for the tube prongs, the socket contacts, and the supporting screws. The contacts, of the side-wipe type, are held in place by solid rivets. The sockets are equally well adapted for plug-in coil mounting or for any type of transmitting or receiving tube.

The coil forms are made with a row of equally spaced holes so that there will be a hole for the end of the wire convenient to any length of winding. These holes also will aid you to get uniform spacing. Coil forms can be obtained completely wound in sets or in blank form, unwound, but with prongs securely riveted to the base and a finished, but not fitted, wooden handle. The latter is held by two screws.

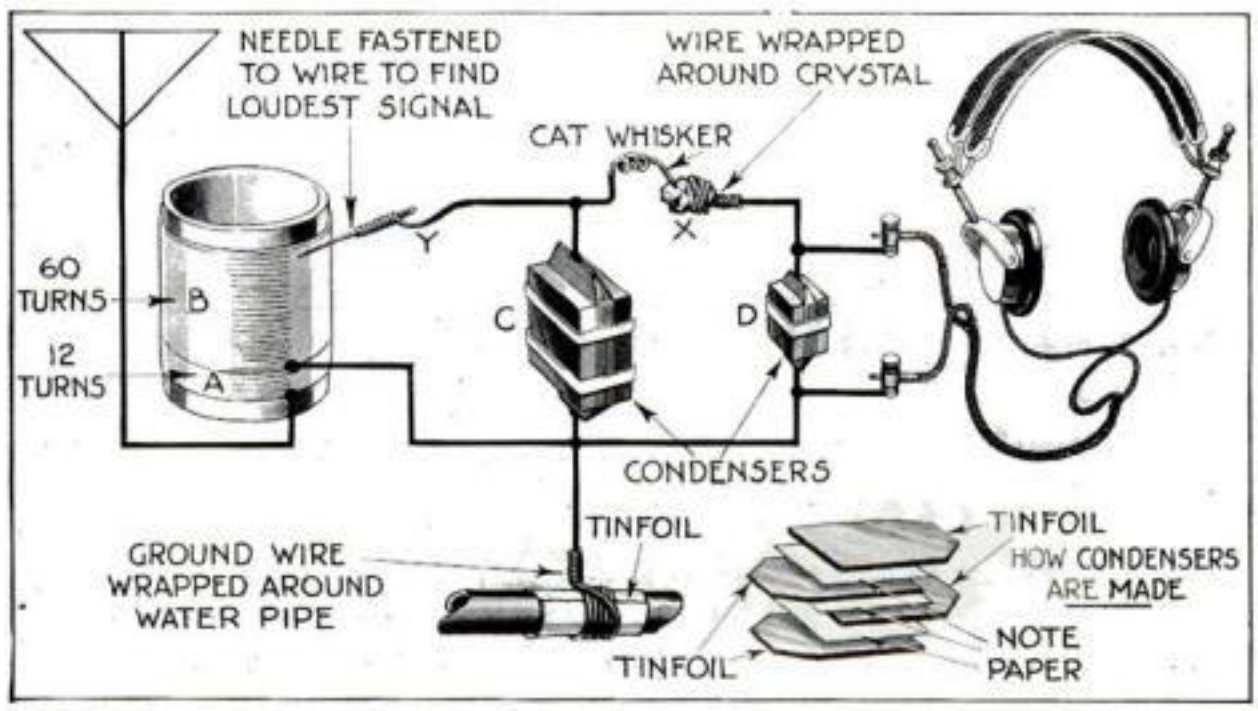


Fig. 1. Picture diagram of crystal set that will work well at short range with headphones

Winding for Short Waves

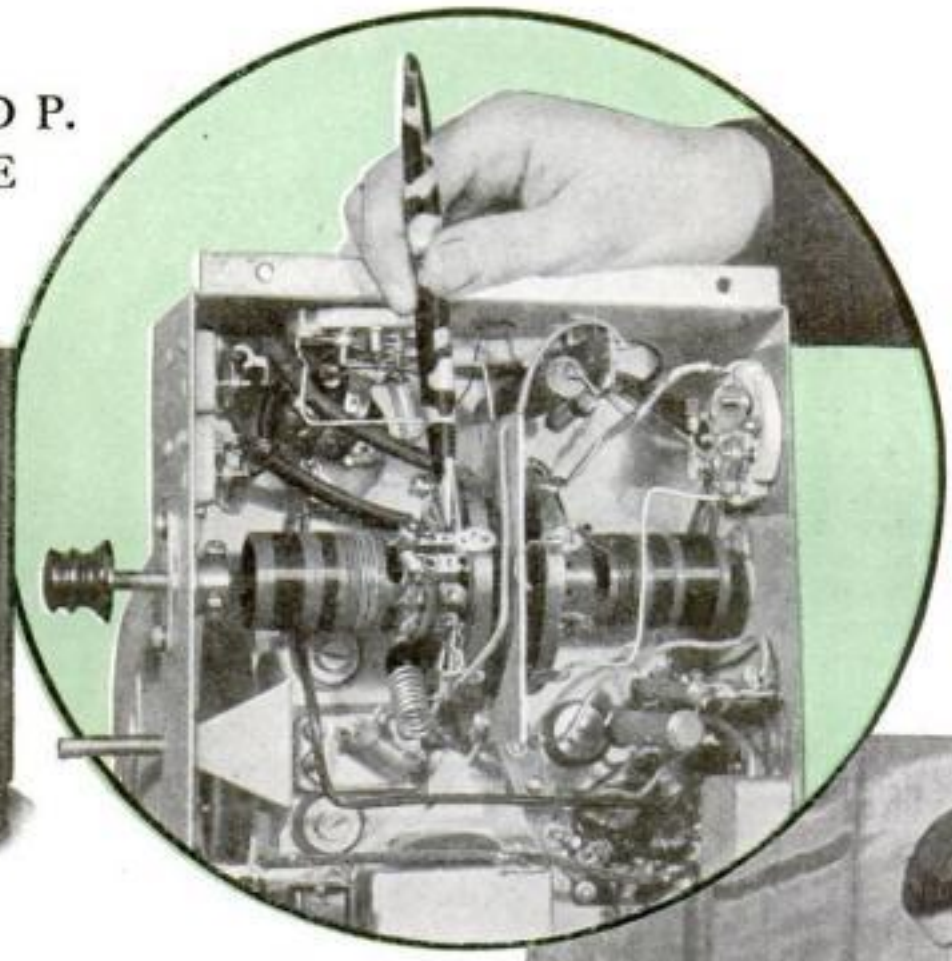
MANY experimenters do not understand the relation between size of wire, kind of insulation, and spacing.

In any spaced coil, where succeeding turns are a considerable distance apart as in short wave coils, the effect of the insulation on the wire is trifling. Assuming a given size of wire, with the usual open space winding, it makes no difference whether you use bare wire, enameled wire, or double silk or cotton covered wire.

In the matter of wire size, it is not desirable to use the very small diameters for short wave work because high frequency current flows mostly on the surface of the wire; the smaller wire, having less surface, offers slightly more resistance. On the other hand, the use of extremely large wire is not to be recommended because the space between turns is cut down and the internal capacity of the coil is increased.

The general shape of a coil also affects its efficiency. Long, skinny coils or very short fat ones are not so good. For best results the coil length should be not more than twice the diameter nor less than the diameter. These limitations apply only to the grid coil, not to the antenna or plate coil.

By ALFRED P. LANE



DISTANCE HUNTERS now aim at radio messages coming from the other side of the earth. Sets on the market are designed to pick up programs on bands below the regular commercial wave lengths and so open a new field of world-wide interest

Hunting Short Waves

IS NEW RADIO CRAZE

EXPLORING new waves is the latest craze in radio. There is a strong demand for sets that will take their listeners off the beaten paths of broadcasting with special emphasis on short wave programs sent out by far-away stations.

So strong has this demand become that radio manufacturers are making plans to supply it. Already several special radio outfits designed to bring in the waves below the ordinary broadcasting length have been submitted to the Popular Science Institute for test. These sets range from simple, compact converter units to complete dual receivers with two complete sets of controls—one for broadcasting and the other for short wave reception. The photo at upper left shows the front view of a set arranged in this way, photographed as it was being given a preliminary inspection before the formal test. In this set, the upper dial and control knobs are used to bring in the regular broadcasting. The lower dial and knobs are used to tune in the short waves.

The picture at lower right shows the back view of another receiver being prepared for test. In this outfit, the loudspeaker is at the top. Below that is the special short wave unit and at the bottom is the conventional broadcast circuit and its accompanying power supply.

It is not practical to build a short wave receiving unit with only a single set of tuning coils that will cover all of the waves in use. Of course it could be done by using coils with several taps on them, but the use of tapped coils is bad practice because the unused ends of the coils cause additional losses.

Various solutions of this problem have been worked out. The simplest, mechanically, is to use a separate pair of plug-in coils for each wave band. However, this construction makes it necessary to change the coils by hand each time you want to shift from one band to another.

The set pictured in circle shows how one manufacturer has eliminated the need for changing coils by hand. Three sets of coils are wound side by side on two coil forms. The latter are placed end to end on a shaft with rotary contact switches between the coils as indicated by the pencil. The knob on the front of the panel rotates the coils and the proper pairs of windings are placed in circuit by the switch contacts.

The back view seen at lower right shows a compromise arrangement. A rotary switch, placed between the two plug-in coils, serves to choose between any two of the three wave ranges available, the choice being determined by plugging in the desired coils.

The man who now has a modern broadcast receiver of either the tuned radio-frequency type or the superheterodyne variety is not being neglected by the manufacturers. Several converter units are being brought out that will work nicely with such broadcast receiving sets. No changes need be made in the wiring of the set you have, the new unit being connected to the antenna and ground binding posts. These converter units are fitted with their own power supply operating from the electric light socket.

What can you hear on the short waves? That depends entirely on how much time you spend at the dials. If anyone buys a short wave combination set or a converter unit expecting to sit down and immediately tune in London, Paris, Hong Kong, and other far-distant points, he is sure to be bitterly disappointed. It cannot be done with any such ease. The great radio companies using short wave receiving circuits costing thousands of dollars and embodying every known refinement cannot guarantee good reception from any transatlantic station at any given time. If you have listened to the scheduled rebroadcasts of foreign short wave transmission, you have noted that most of the time the reception is exceedingly poor when compared with local reception standards, and sometimes it is unintelligible.

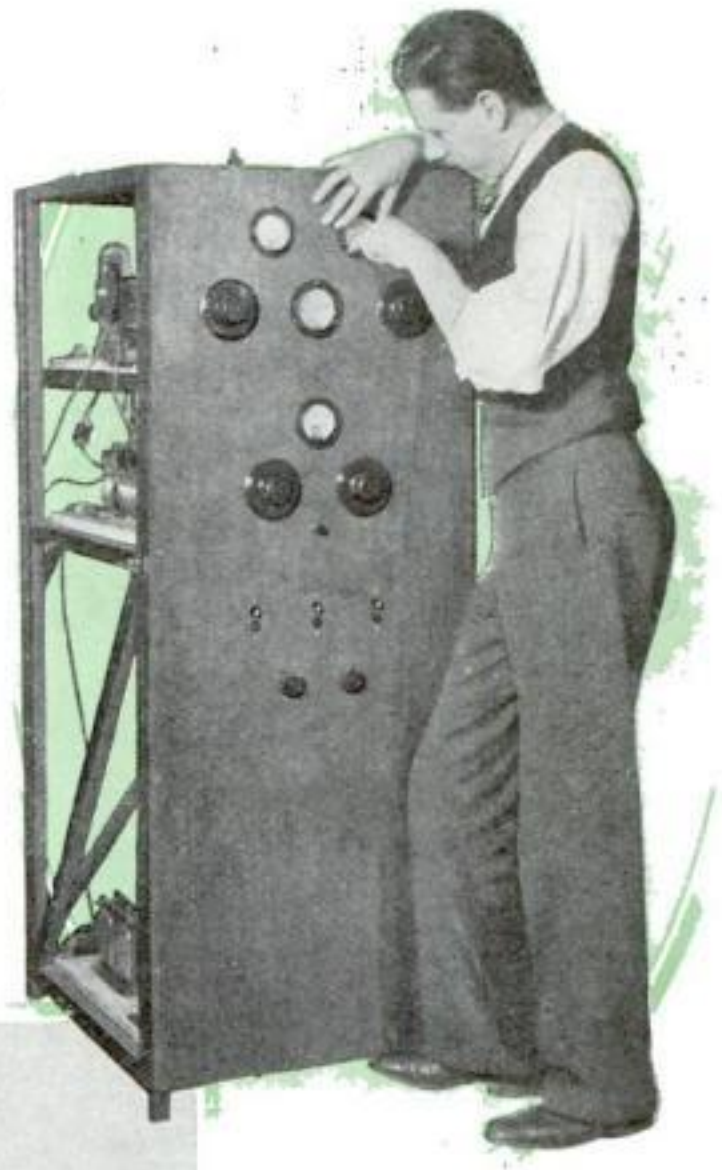
You probably will have little difficulty in tuning in the commercial shore-to-ship radiophone, at least the United States end of the conversation. There is no law against thus eavesdropping on the telephone conversation, but there is a law against repeating anything you hear.

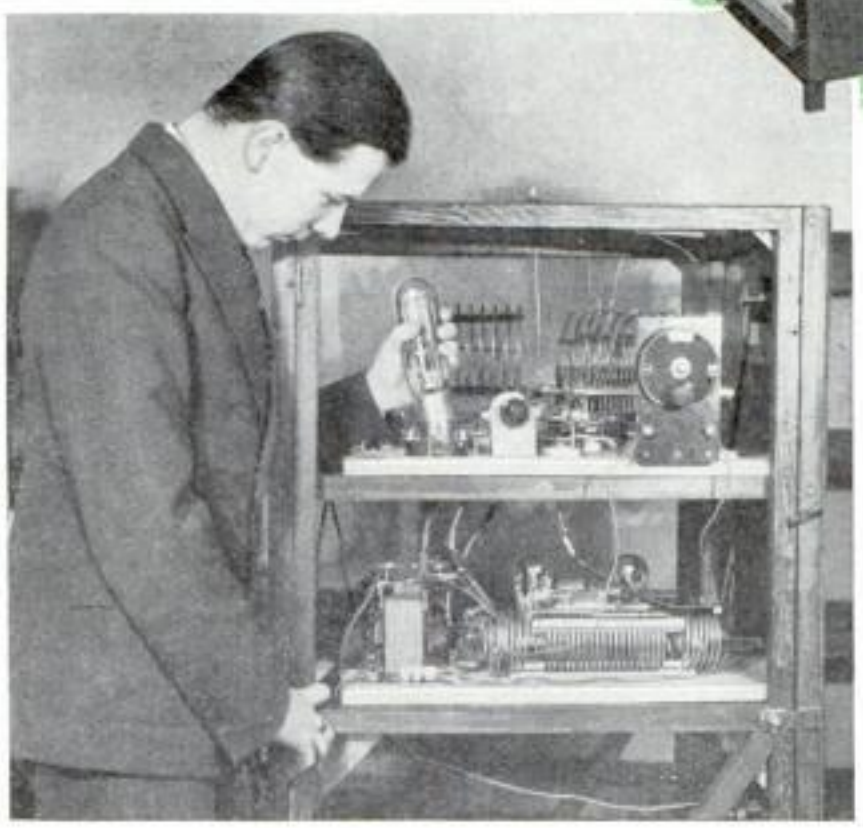
Other lines of conversation to which your radio "ear" may be tuned are police alarms and ground-to-plane and plane-to-ground aircraft radiophone service. You will get the thrill of your life if you happen to tune in on a plane when anything goes wrong and a forced landing is in prospect!

JOHN CARR *gives basic facts about*

Radio Transmitters

FOR ALL AMATEURS





Above, putting the last dial in position in the panel of an amateur transmitter which has been put together by a careful workman. At the left, a side view of a transmitting outfit into which a fifty-watt power tube is just being inserted

EVERY radio amateur's first ambition is to get "on the air." Before this ambition can be realized, however, he must pass the United States Government examination for amateur radio operators and also obtain a Government license for his proposed station. The requirements were discussed in a previous article (P.S.M., Mar. '32, p. 72). Now I want to explain just what you as an amateur must know about radio transmitters in order to qualify. Fortunately, the requirements are simple. Briefly, you must know enough about the theory and operation of a typical amateur radio transmitter to build one and handle it intelligently.

The theory of all continuous wave radio transmission is based on the action of a radio vacuum tube when it is oscillating. Those of you who have used one-tube regenerative radio receivers are familiar with vacuum tube oscillation. You know that when you push the regeneration control too far, the set produces whistling noises every time you tune to a station. The diagram on this page shows the basic circuit to produce electrical oscillations by means of a vacuum tube.

Suppose you have any ordinary type of vacuum tube such as a 201A, a 230, or a 227. The filament terminals *F* and *F* are connected with a battery *X* to produce the necessary heat. Then there is a tuning coil or inductance *B* across which is connected a variable condenser *V* and the combination is connected with one end to the *G* or grid terminal of the tube and the other to the minus end of the filament. Another coil *C* is placed close to the end of coil *B* and connected as shown with a forty-five- or ninety-volt B battery in the circuit. If you used a heater tube such as the 227, the cathode would be the active part in the circuit, the *H* terminals carrying only the alternating current for heating the cathode.

As the filament warms up to red heat, it will throw off a steady glow of electrons which will pass through the grid to the plate and thereby allow a flow of current in the plate circuit because of the electrical pressure exerted by the B battery.

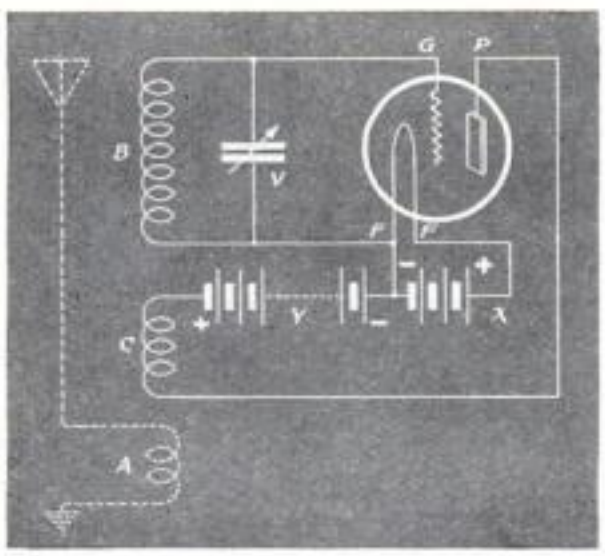


Diagram of basic circuit to produce electrical oscillations in transmitter with vacuum tube

In theory you will then have a steady flow of current through coil *C* and nothing will be going on in coil *B*. In practice, however, infinitely small changes in rate of current flow will occur in coil *C*. These changes will produce, by electromagnetic action, corresponding current pulsations in coil *B*.

These current pulsations in *B* will, in turn, produce corresponding changes in the voltage of the grid *G*. Now any change of the grid voltage affects the flow of current between the plate and filament and consequently the microscopically small original variation in current flow builds up into a strong oscillation. The rate or frequency of this electrical oscillation will depend on the setting of condenser *V* because it forms, with coil *B*, a tuned circuit that will oscillate much more readily at the frequency to which it is tuned.

The maximum strength of the oscillation in the circuit is governed by the electrical resistance of the wiring and other parts. Once the oscillation starts it will continue until either the tube or the batteries give out.

If you should put another coil *A* close to coil *C* and connect *A* to antenna and ground, oscillations would be produced in it by electromagnetic induction and the oscillating tube circuit would, therefore, "pump" oscillations into the antenna.

It is evident from this description that a full-fledged outfit capable of transmitting radio signals could be built around a single vacuum tube of the ordinary type.

The cost of building an amateur transmitter is roughly in proportion to its power, as is its upkeep. More elaborate apparatus and much more expensive tubes are used in the powerful transmitters, and the cost of tube replacements and electric power naturally is more.

The essential parts of a radio transmitter consist of the vacuum tube or tubes and the tuning inductances and condensers that make up the circuit itself, the power supply, and the antenna.

The simplest form of construction is the "bread-board" arrangement, with the parts fastened to a plain board.

In my next article I will describe the construction of a low power amateur radio transmitter well suited to the beginner.

WHY Motors Die Suddenly on the Road ?

"If you budding young auto geniuses don't know what stops a car," Gus said, "I'll tell you"

By Martin Bunn

"GUS," asked Jeff Harmby, "when your motor stops suddenly on the road, what's most likely to be the trouble?"

Gus Wilson, half owner of the Model Garage, smiled at the two young automobile enthusiasts who had dropped in during his lunch hour. He shoved the empty lunch box aside and lighted his pipe.

"Jeff," he grunted between puffs, "you ought to be ashamed to ask a question like that after all the miles you've driven. Tell me the answer yourself!"

"I'll bet you can't," chuckled Tim Hibbert, the other of the two young men.

"Better than you can, anyhow," Jeff snapped. "The thing that stops most motors is a blown-out condenser on the ignition system. Isn't that so, Gus?"

"I thought you were telling me," Gus grinned. "What do you say, Tim?"

"Aw, Jeff's all wet," young Hibbert replied. "Of course a blown condenser will stop the motor—suddenly, too—but it's a rare trouble."

"Score one for Tim," said Gus turning to Joe Clark, his partner. "If this pair of auto geniuses are going to debate what makes a car stop on the road, we'll have to check up on them. Tim certainly is right in saying that a blown condenser is a rare trouble. Lots of cars end their lives in the scrap pile without ever having it. Still I think we ought to put down a half point for Jeff because he picked one of the two ignition troubles that can stop a car as suddenly as though the switch was turned. The other is a burned-out ignition coil. When that happens, nothing short of a new part will get the motor going again. No makeshift stunt will do.

"YOU can fix a blown fuse by wrapping tin foil around it. You can short out the dead cell in the battery if it gets so bad no current will flow. Or you can get the car going when the whole battery is shot by disconnecting it and having somebody push you so you can start and drive home slow on the generator alone. I've seen cars get home with a cracked distributor head held together with tape, and contact points working with a rubber band for a spring. I've seen broken wires held together with a piece of chewing gum, but I never yet saw anyone wangle a condenser or spark coil back to life.

"Well, Tim," he broke off, "what's your idea of the thing that's most likely to stop a car on the road?"

"Dirt in the spray jet of the carburetor or water in the gasoline," Tim promptly suggested.

"Rats!" Jeff snorted. "Just because the tank on your old bus is so full of muck and water that you get stuck with a clogged carburetor doesn't prove all automobiles are that way."

"SCORE'S even again," Gus laughed. "You're right, Jeff. Clogged carburetors certainly aren't the most frequent cause of road stops, especially in cars less than two or three years old. Last year we had more trouble with 'vapor lock' than we did with clogged carburetors."

Gus says:

The human head is not supposed to act like a pendulum bob, so when you ride in a car minus shock absorbers over a road filled with "thank-you-marms," you get a pain in the neck. Shock absorbers, when they're adjusted right, keep the car from pitching. The new kind that are set without getting out of the driver's seat can be adjusted to suit any kind of a road, and what's more important, to suit any load you may have in the car.

"I never had that. What is it?"

"You can blame last year's troubles with vapor lock on good gas," Gus explained. "A few years ago the gas was so poor that automobiles had to have special 'hot-spot' manifolds and other heating gadgets to get the gasoline to vaporize at all. Then came overproduction in gas and refiners faced such stiff competition that they improved the quality of their products. Automobile manufacturers have been making better motors, too, and last year the more efficient and hotter-running motors, combined with gasoline that turns into gas at a lower temperature than the old stuff, brought a new trouble we'd never bumped into before.

"YOU'D be breezing along at a good smart pace on a warm summer day and all of a sudden the motor would begin to spit and blow back just as it does when water gets into the gas line. Sometimes the motor would stop dead. Then, after you'd spent a few minutes trying to find the trouble, you'd step on the starter and she'd tick over as though nothing had happened. At first they blamed it on water or dirt in the gas line, but when it kept on happening, the engineers got busy and found that when the motor got just so hot, the gasoline in the pipe line near the carburetor started to boil. Sometimes it would boil in the carburetor bowl itself. Then nothing but gas vapor went into the carburetor with the air and the mixture got too thin to burn."

"By golly!" said Tim excitedly. "Maybe all that clogged carburetor trouble I've been having is vapor lock. I put in a new gasoline pipe last year and I remember I made it shorter than the old one by running it alongside the exhaust pipe. I'll move it over to the other side of the frame today." *(Continued on page 102)*

J. DANNER BUNCH designs
a new and extraordinary....

Flying Model

OF A FAMOUS WAR PLANE

... *The* Scouting Experimental *No. 5a*

THE famous Scouting Experimental No. 5a—or S. E. 5a for short—was the Sopwith plane that finally gave the Allies supremacy in the air during the World War. It was flown by some of the greatest aces—Ball, Bishop, Barker, Mannock, Hawker.

Although it is a small ship with a wing spread of little more than 26 ft., the S. E. is every inch an airplane. It has a rapid take-off, an excellent climb, good top speed, and lands slowly. Pilots who have had experience in the S. E. almost invariably pronounce it to be one of the most satisfactory ships to fly that they have ever been in.

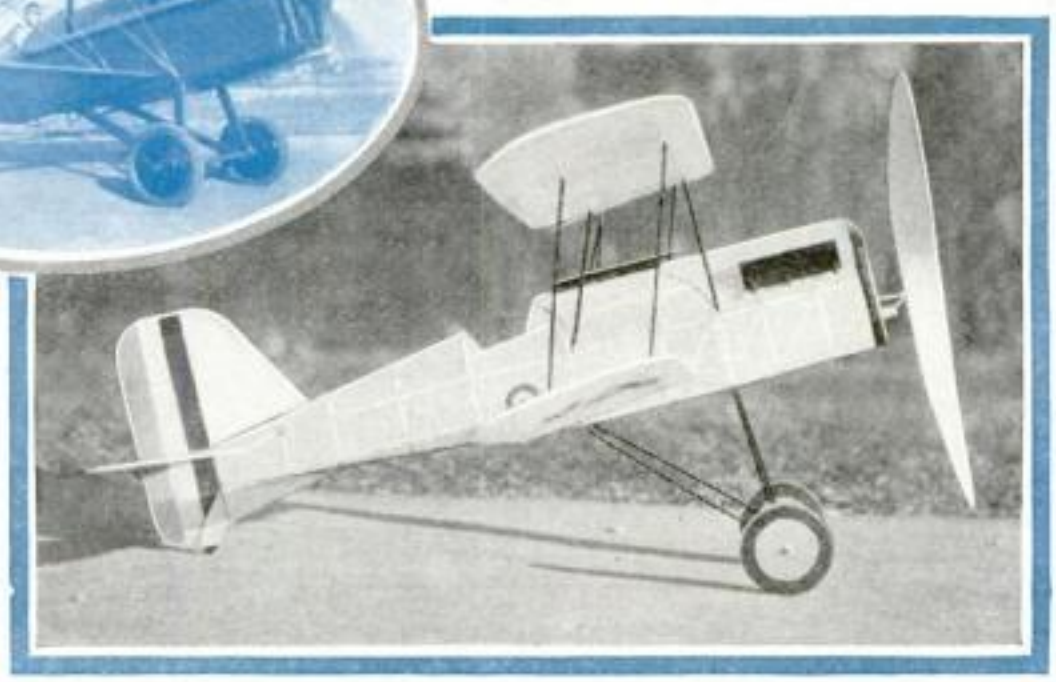
The design of the S. E. makes possible one of the very best of flying scale models. The model illustrated is changed very little from true proportions. It is an excellent flyer and exceptionally stable.

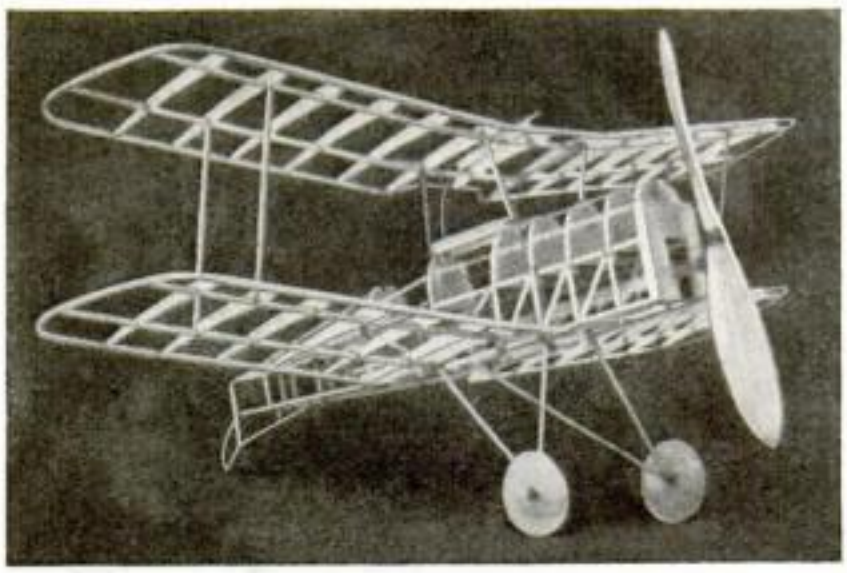
To the thoroughly experienced model maker who is familiar with the construction of flying scale models, the drawings on the following page, small as it has been necessary to make them, will prove self-explanatory. The majority of those who wish to build this remarkable little plane, however, can save themselves a great deal of time and effort by sending fifty cents for POPULAR SCIENCE MONTHLY Blueprints Nos. 168 and 169. These contain much larger drawings than it is possible to publish within the

A flying scale model of the S. E. 5a. It has a wing spread of 30 in. and is 22 in. long

A full size S. E. 5a is shown in the photo above with Mr. Bunch in the cockpit. His knowledge of aviation is based on long practical experience in the air and at the designer's board. That is why his models are always masterpieces

At the right is a side view of the new model





A view of the model before the covering was applied. Balsa wood is used for most of the parts, but the "prop" is of pine

limitations of a magazine page and, what is even more important, they are accompanied by a very long Home Workshop bulletin giving easily-followed step-by-step instructions in the most minute detail.

The specifications of the model are: Span, 30 in.; chord, 5⅛ in.; length, 22 in.; gap, 5⅛ in.; stagger, 1½ in.; incidence of main planes, 5 deg.; incidence of stabilizer, 0 deg.; dihedral, 5 deg.; weight (author's model), 2⅝ oz.; propeller, 12 in.; motor, 12 strands of ⅛-in. flat rubber.

This model represents the most advanced practice in design and construction. Many model makers, for example, have built the S. E. with the lower longeron extending forward from the lower rear spar in a straight line and have been greatly disappointed at the awkward appearance of the fuselage. The curve at this point, although slight, makes all the difference between a graceful and a clumsy body.

The full sized S. E. has a cross-axle landing gear, but this arrangement, if copied in a model, is too rigid for best flying results, so stub axles are used. The covering of white Japanese tissue is doped on a wooden frame before being applied to the model in order that the light framework of the model itself will not be distorted. This method is somewhat more difficult than the usual one, but it is well worth the extra work.

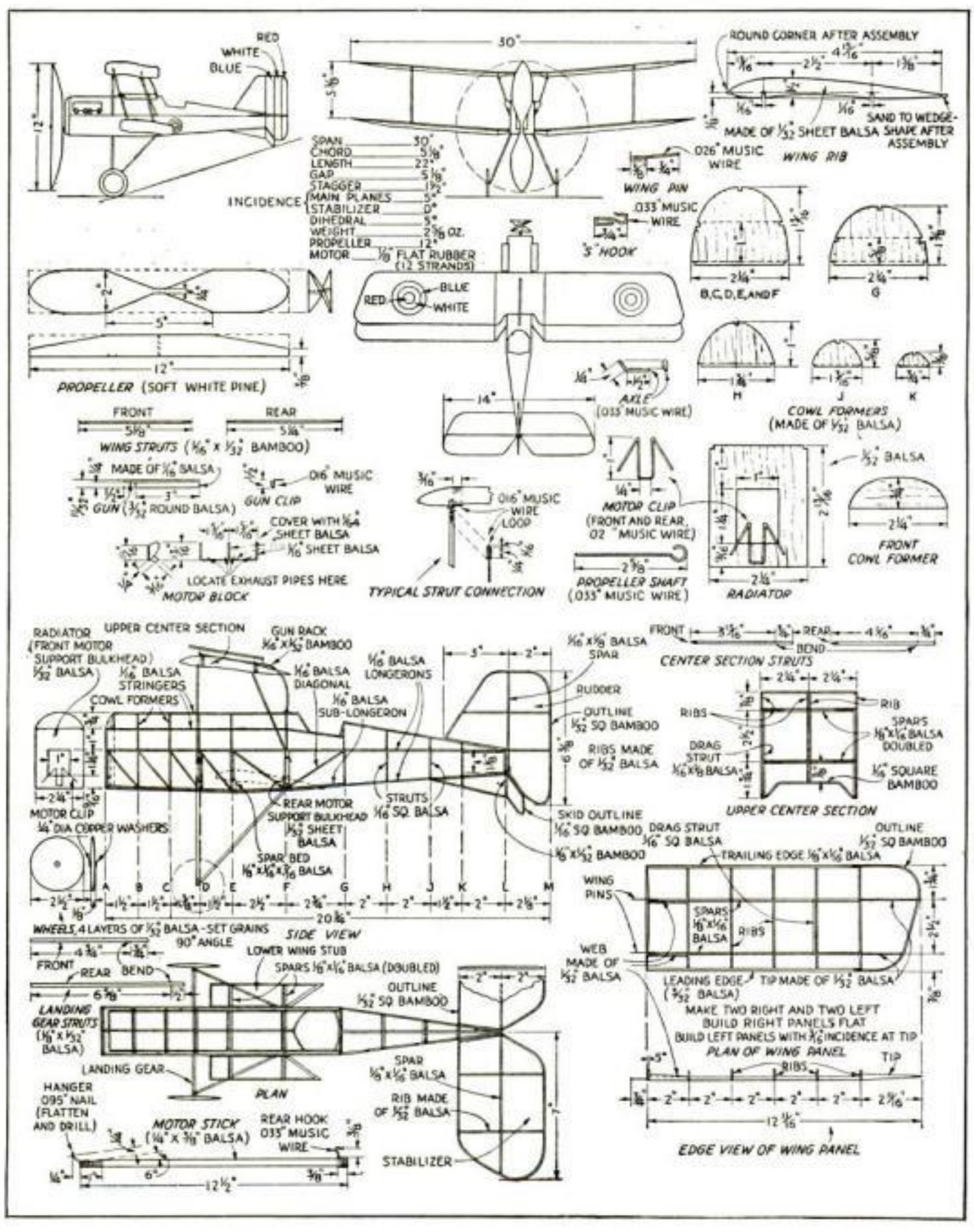
The only decoration the model requires, since the original S. E. planes were usually plain aluminum, is the addition of the insignia. They are cut from red and blue Japanese tissue and cemented to the covering while in the doping frame between the first and second coats of dope. The circles have red centers, a white ring, and an outer ring of blue. The first rudder strip is blue, the second white, and the last red. Give all struts, the wheels, cylinder blocks, guns, and radiator two coats of banana oil, then a coat of black lacquer. The radiator core and the inside of the wheels should be silver.

If built strictly to the design shown in the drawings and the specifications given in the bulletin, the model should make a smooth even glide. If it stalls slightly, the motor stick may be moved forward about ½ in., and if this does not correct the glide, a heavier propeller with thicker blades and hub must be carved to move the center of gravity forward. Should the model glide too steeply or dive, fit a longer motor stick. In this way it is easy to bring the model into perfect balance.

After the model glides correctly, the first flight should be made in calm air after winding the rubber by hand until it has a row of single knots. Hold the model by its landing gear, well overhead, release the propeller, and launch it in level flight. It will soar away and land "dead stick" from a flat glide.

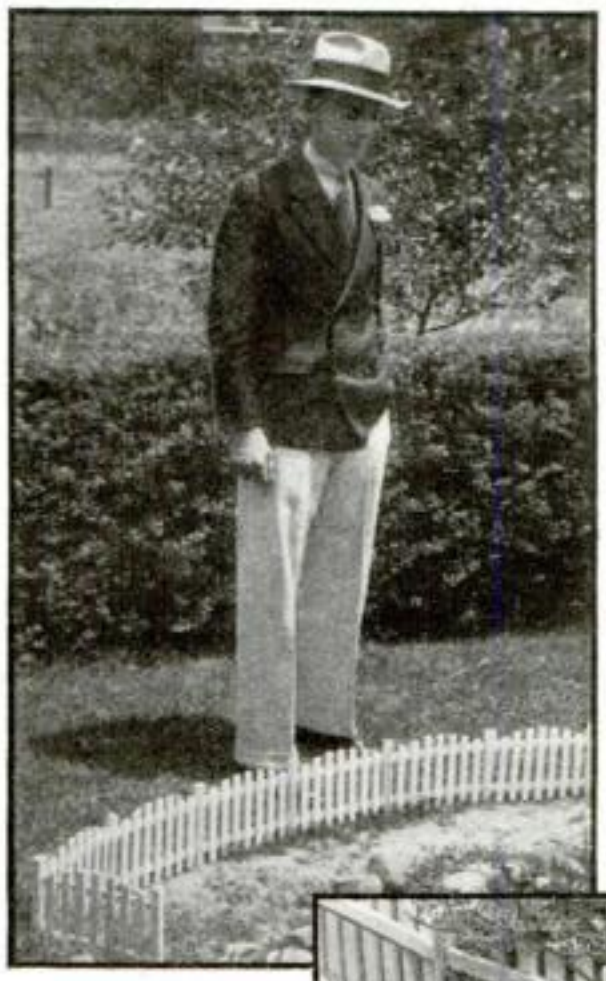
When you have become familiar with its behavior, try a full power flight. Remove the motor stick, have someone hold the propeller, and hook the S-hook into a winder. Stretch the rubber out about two and a half times its normal length, then gradually close in as you wind. The motor may be wound about 180 turns. Snap the motor stick into place and launch the model in level flight. It will zoom away in a tremendous climb, circling at a high altitude, and then glide down to a dead-stick landing. In the air the S. E. looks like a full sized ship and is in every respect one of the most efficient and satisfactory of flying models.

A flying model of the Nieuport, another famous World War plane, will be described in a forthcoming issue.



Working drawings for the S. E. 5a as laid out by the author, who is one of the leading designers of model airplanes. For larger drawings and full instructions, send for Blueprints Nos. 168 and 169 (see page 108)

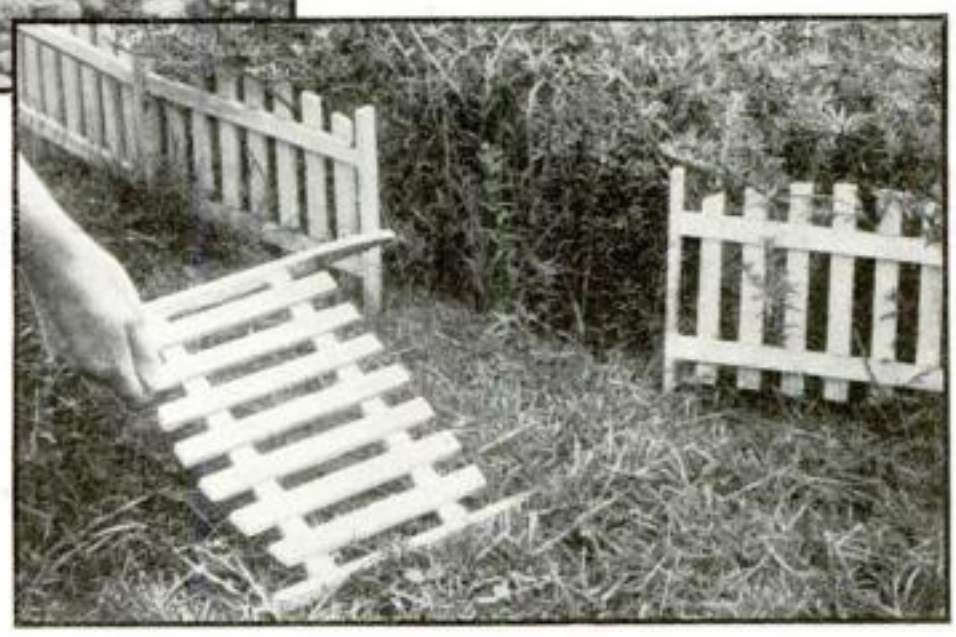
MINIATURE FENCE GUARDS FLOWER BEDS



A MINIATURE fence makes a decorative novelty for any garden. It can be used to keep flowers in their place, protect a water-lily pool, or serve as a polite warning to intruders to keep off the grass.

Such a fence should be built in separate sections so that it can be set up in any form desired. Those pieces which serve as the posts must be left long enough to be driven into the ground and their ends sharpened. Fasten the parts together with small nails, and give the wood two coats of high-grade outside oil paint. When the fence is put in place, each end-piece rests against that of the adjacent section.

It is advisable to treat the pieces that are driven into the ground with some kind of preservative such as creosote to prevent rotting. Copper sulphate solution may be used, the pieces being boiled in it before being assembled or painted. However, paint alone will afford protection for several seasons. The fence can be made to last longer by taking it indoors during the winter.



The fence set up around a bed of flowers and, at the right, a close-up view to show the construction. The end posts of each section are long and pointed so that they can be driven into the ground. The parts are merely nailed together to form the desired design

This truck for a camera tripod is an aid when many photos are to be made indoors. It keeps the camera level, is easily moved about, yet will not upset

WHEELED TRUCK BUILT FOR CAMERA TRIPOD

WHEN many photographs are to be made indoors with a camera mounted on a tripod, it will be found that much time may be saved and better pictures made by using this three-cornered wheeled truck. It keeps the camera level at all times, is easily moved, and cannot be upset. Three hardwood pieces 36 in. long are used, the ends are mitered to an angle of 60 deg., and they are glued and screwed together to form a triangle. A triangular block is then screwed to each corner to take the casters. The tripod legs rest on these blocks inside each corner of the frame.—K. M.

SHELF FOR CAMP CHAIR

A SMALL camp chair can be made to hold tobacco, books, papers, and other things for which it is hard to find a convenient place while in camp. Simply trim off part of a heavy cardboard box, preferably one side and the bottom, until it forms a troughlike rack or shelf which will fit in the angle of the legs under the canvas seat.—R. E.

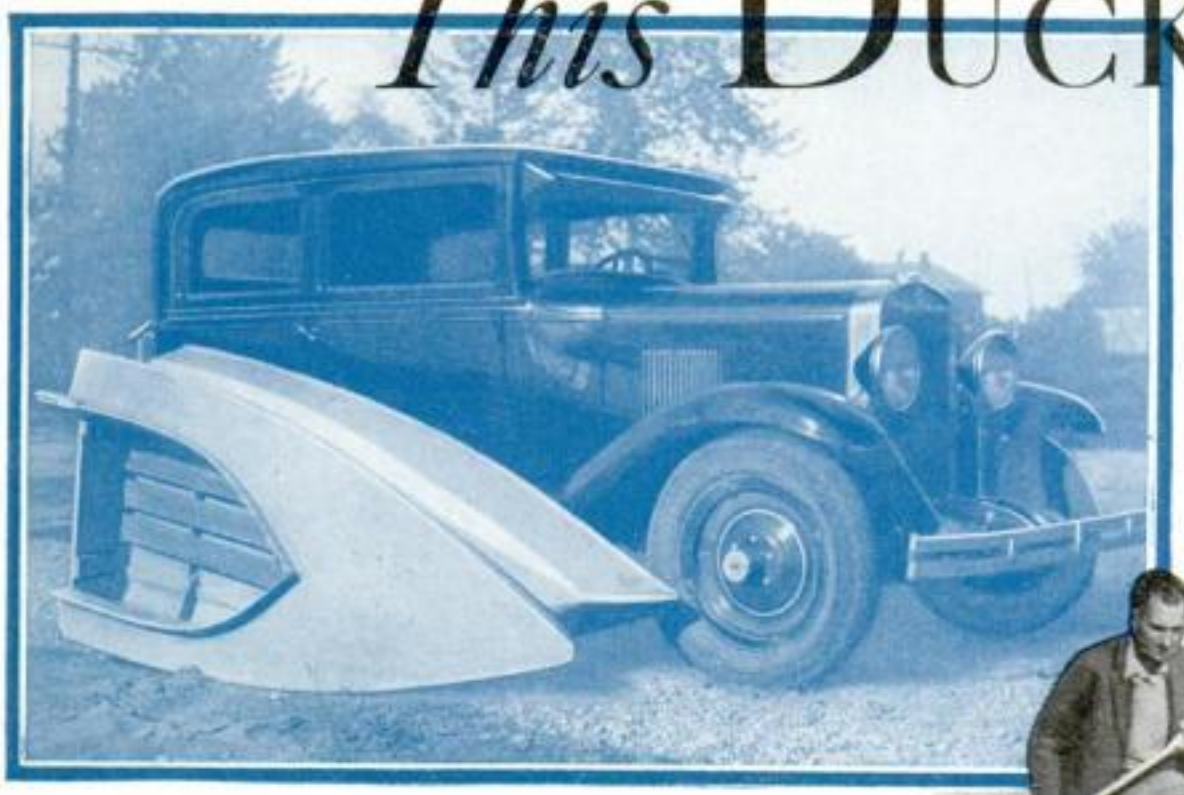
A MERCURY DRILL-TEMPERING OUTFIT

IF A TWIST drill is tempered in mercury, it will become so hard that it can be used for making holes in glass, tempered clock springs, and other substances which cannot be drilled with ordinary drills. The process consists simply of heating the drill to redness and then plunging it into mercury. The cost of the mercury makes it desirable to use as little as possible, therefore it pays to use a simple tempering outfit like that illustrated. Obtain a 6-in. pipe nipple and cap, a diameter of about ½ in. being suitable for drills up to ¼ in. in size. You will find it convenient to make a support for the pipe by boring a hole in a block of wood. From a piece of iron wire and a strip of sheet iron form a spoonlike device that will slide easily inside the pipe; this is to lift out the drill after tempering. Put an inch or two of mercury into the tube, insert the lifter, and you are ready to quench the red-hot drill. Drills tempered in mercury are of glasslike hardness, but they also are brittle.—E. B.

Tempering a small twist drill to extreme hardness by plunging it while red-hot into a container of mercury

This DUCK BOAT Folds in Two

Built for Twenty Dollars, Weighs Only Seventy Pounds; Can Be Paddled, Rowed, or Sailed



So that it can be readily transported, the duck boat is folded in two by means of a long hinge across the bottom

Light and easy as the boat is to handle, a man can stand in it without danger of capsizing

By WILLIAM JACKSON

WITH the coming of vacation days and all the joys of camping, fishing, and hunting, there are many thousands of readers who will miss a good deal of pleasure because they do not own a boat that can be transported quickly and easily from place to place. That lack, however, can be filled by building a folding duck boat like the one illustrated. It cost the author only twenty dollars for materials.

The weight of the original was 70 lb. Because of the bottom construction, it is somewhat more stable than the average duck boat; an adult can stand up in it without fear of capsizing. The fact that it is only 13 ft. long and can be folded, allows it to be fastened to the side or rear of an automobile. The folding feature, of course, can be dispensed with if not required, and the boat built in one piece. In that case, simply make section No. 5 in the form of a frame.

What will help you more than anything else is a set of full size patterns for the boat. You can obtain these, together with a blueprint containing the complete drawings, for $1.75, or the blueprint alone for 25 cents. Use the coupon on page 108 and order the blueprint by its number, which is 170.

Any ordinary set of carpenter's tools, with the addition of a few clamps, will suffice for the construction. First make the form upon which the boat is to be built. A 2 by 10 in. by 12 ft. plank of yellow pine or any rough lumber will do, provided one edge is straight. A long slot will have to be cut in the form to receive the bulkheads; this is indicated in the drawings. Make the two bulkheads exactly alike, clamp them together, and insert them in the form. These two parts must be kept together as if they were one.

It is necessary to draw full size paper patterns of the frames unless you send for set made from my own templates. After you have cut out the frame material, lay the members in place on the patterns and fasten each joint with two 1⅛-in. copper rivets or two ¼ by 1¼ in. carriage bolts. As the hull is alike forward and aft, the frames are made in pairs.

When the frames are finished, set them in their proper places on the form. Lay a light batten along them and mark the bevels. Remove the frames and bevel the edges so the planking will lie evenly. Return the frames to the form and fasten the keel to each frame and bulkhead with two 1¼-in. No. 7 screws. Let the keel project over the end of the form about 3 or 4 in. and fasten it to the form with a few screws; this will make it unnecessary to use clamps. Be sure, however, to remove the screws preparatory to planking. The stem now may be beveled properly and attached to the keel with one 1¼-in. No. 7 screw.

The chines are attached to each frame with one 1¼-in. No. 7 screw. Bevel the chine at the stem end, and fasten the chine to the keel with one 1-in. No. 7 screw. The bilge battens are fastened to the bulkheads, frames, and stems with one 1¼-in. No. 7 screw; and each inwale is fastened with one 1-in. No. 7 screw. When fastening the battens and chines, start at the center section and work upward toward both ends. First fasten one side, then the other, to prevent pulling the hull out of shape. With the frame completed, bevel off the bilge battens and all projections so the planks will lie evenly.

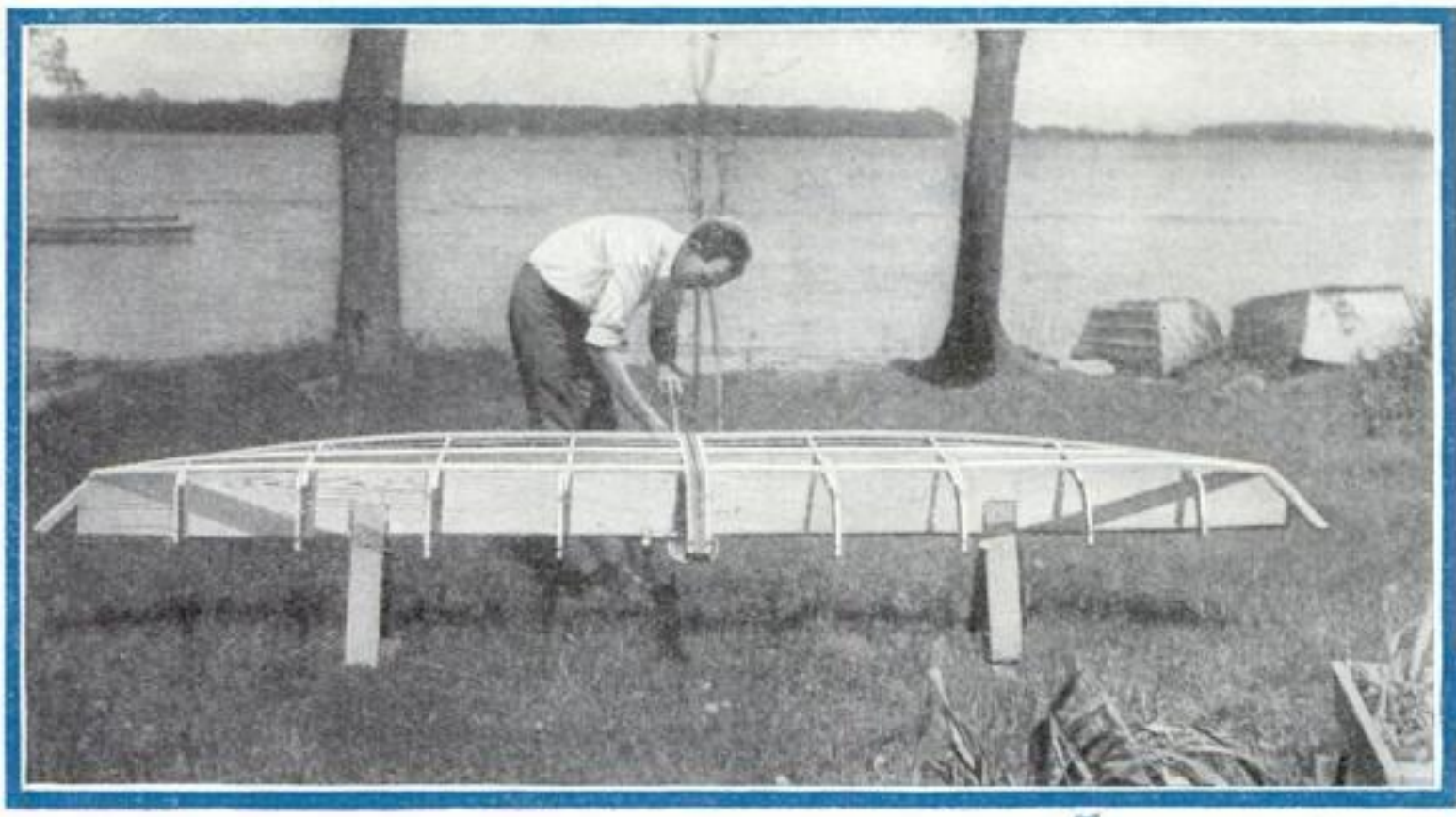
When the frame is faired and trimmed, apply the bottom planks first (⅜ in. planking may be used with battens under the seams, if preferred). Trim the edges of the ½-in. planking material so that the inner edge fits tight and the outer edge forms a slight V to receive the calking. Coat the bulkheads with marine glue and lay strips of cloth on the glued surface. Clamp the first plank exactly in the center of the bottom and fasten it to the bulkheads, keel, and frames with 1¼-in. No. 7 screws spaced about 2 in. apart. Clamp the remaining two planks to the bottom, mark them to conform to the chine, and saw out. Coat the chines with glue and cloth and fasten as before. Bevel off the edges of the planks at the chine, obtaining the angle by laying a piece of wood across the bilge batten and chine.

Clamp the side planking material to the sides. Mark around the inwales and stem and let the planking project over the bilge

ALTHOUGH called a duck boat, this light, staunch little craft need not be restricted to hunting. If oarlocks are fastened on the side deck and oars are used, it becomes a fast, serviceable rowboat. If rigged with a canoe sail, it can be used for sailing.

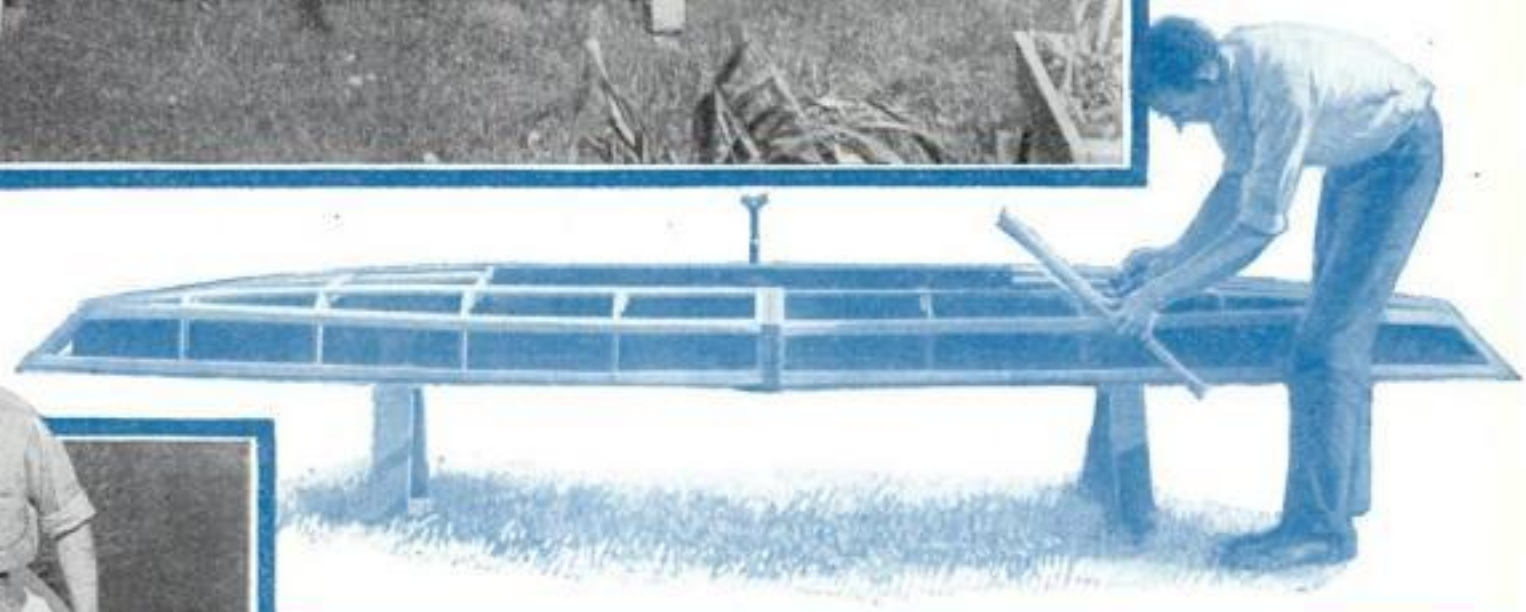
Mr. Jackson, who is a naval architect as well as a practical boat builder, found in extensive tests that the boat is easier to paddle than many factory-built hulls and that it is quite safe with two men even in rough water, although designed primarily for shallow water.

This is the fourth of a series of boats designed by Mr. Jackson especially for POPULAR SCIENCE MONTHLY. Blueprints and full size patterns are available for all; see the list on page 108.

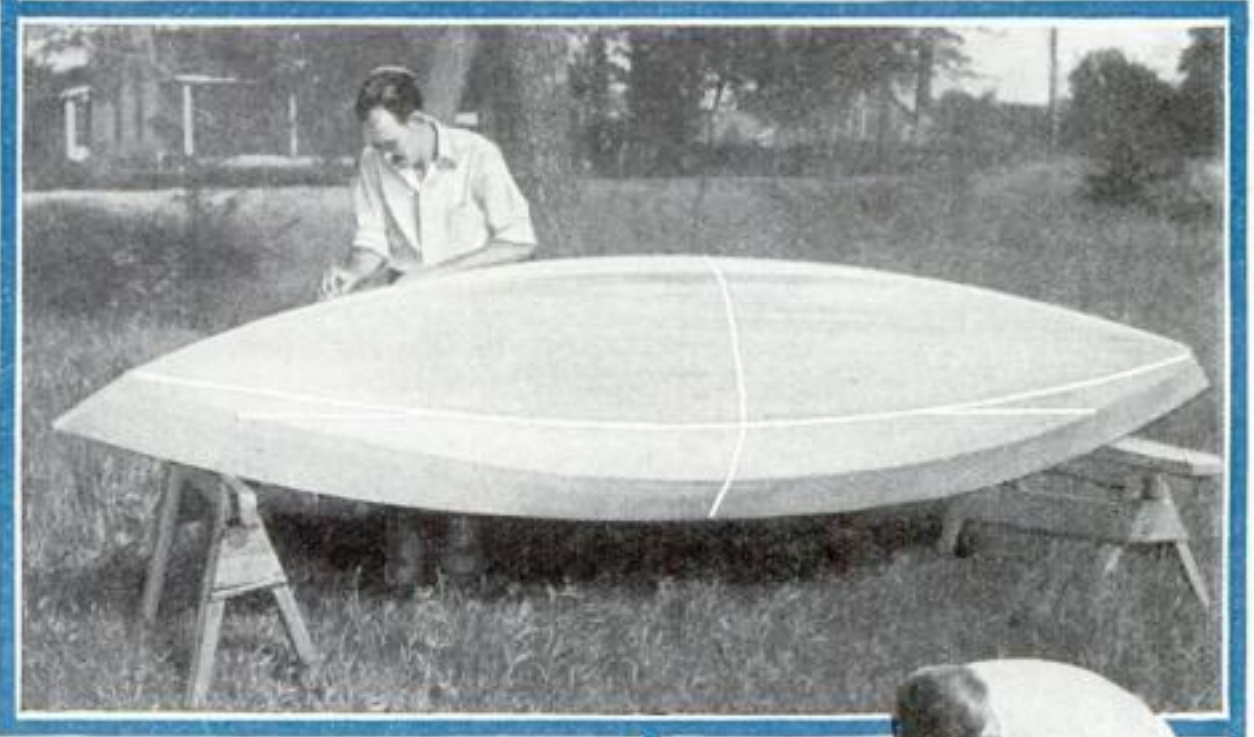


The framework is built on a form made from a heavy plank. The bulkheads are fitted in a slot at the center of the form and are kept together throughout as if they were one piece

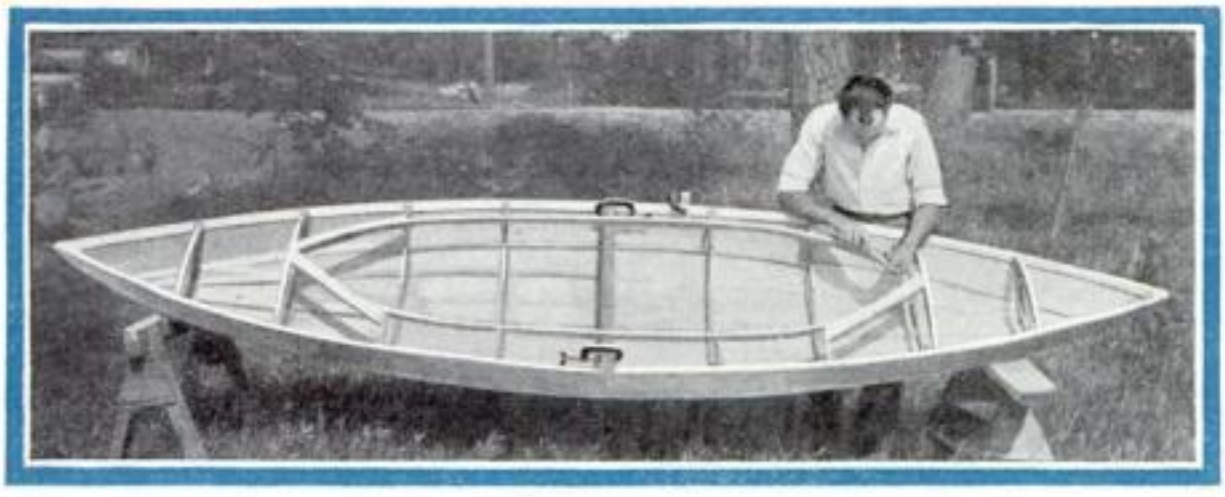
The photograph below shows the frame nearing completion. The bilge battens (see the drawing on the following page) should be beveled off carefully, and all projections removed so that the planks will go on without difficulty



Mr. Jackson prefers to paddle the boat in this position. It should be noted that the folding feature may be dispensed with if not required. In that case, simply make section No. 5 in the form of a frame. The planking is shown at the right. The four bilge planks are each made in two pieces to reduce waste



How the deck and cockpit beams are placed and the inside coaming strips are attached is shown in the photograph below. The view at the right illustrates the application of the bottom planking. A duck boat anchor can be added by fastening a pipe in the center of each deck and letting it extend flush with the bottom planking, so an iron rod can be pushed through



batten so it can be beveled off properly. Coat the bulkhead and bilge batten with glue and cloth. Fasten the planking to the bulkheads, frames, and stem with 1-in. No. 7 screws spaced about 2 in. apart, and to the bilge batten with 1-in. copper clinch nails spaced about 2 in. Bevel off the side planks along the bilge batten before fastening them.

Each of the four bilge planks are made in two pieces as shown in one of the photographs. A ¼-in. batten is placed on the underside of the joint and the edges are fastened to it with 1-in. clinch nails. Before fastening the bilge planks, coat the chine edge and the batten edge with glue and cloth. Fasten the bilge planks to the bulkhead and frames with 1-in. No. 7 screws, and to the bilge batten and chine with 1-in. copper clinch nails.

After the hull is planked, remove it from the form and trim the wood flush with the inwale. Proceed to fasten the deck and cockpit beams in their proper places, using 1¼-in. No. 7 screws. Then attach the ⅜ by 1¼ in. inside coaming to each beam with one 1-in. No. 7 screw.

Reënforcing pieces are fastened to the deck and cockpit beams with 1¼-in. No. 7 F. H. screws and to the inside coaming with 1-in. No. 7 screws and spaced about 2½ in. apart. When all the decking is fastened, trim the edges evenly and sand the hull.

MATERIALS
for the Duck Boat

Planking: Bottom, 3 pc. ½ by 8 in. by 12 ft.; bilge planks, 2 pc. 5/16 by 10 in. by 12 ft.; side planks, 2 pc. 5/16 by 10 in. by 14 ft., white pine, cedar, or cypress.
Decking and inside and outside coaming, 3 pc. ¼ by 8 in. by 14 ft., white pine, cedar, cypress, or fir.
Frames, 1 pc. ½ by 10 in. by 10 ft., oak.
Stems, 1 pc. 1½ by 1¾ in. by 2 ft., oak.
Bulkheads, 1 pc. ¾ by 8 in. by 8 ft., cedar, cypress, white pine, or fir.
Keel, 1 pc. ½ by 1½ in. by 12 ft., oak or fir.
Bilge batten, 2 pc. ½ by 1½ by 12 ft., oak, fir, or spruce.
Chine, 2 pc. ½ by 1¼ in. by 12 ft., oak or fir.
Inwale, 2 pc. ¼ by 1¼ in. by 14 ft., oak, fir, or spruce.
Flooring, 3 pc. 5/16 by 4 in. by 8 ft., yellow pine.
Molding, 2 pc. ¾-in. half-round molding, 14 ft. long, white or yellow pine.
Hardware: 2 gross 1¼-in. No. 7, 3 gross 1-in. No. 7, 1 doz. 1¾-in. No. 8 F. H. gal. or brass screws. ½ lb. 1-in. copper clinch nails. 3 doz. 1⅛-in. copper rivets or ¼ by 1¼-in. carriage bolts. Two ¼ by 3½ in. and two ¼ by 1½ in. carriage bolts. Four ¼-in. wing nuts. 1 continuous piano or hatch hinge, 1½ in. by 2 ft. 2 oz. ½-in. tacks.
Miscellaneous: 5 yd. heavy muslin or light canvas. ¼ lb. cotton wicking calking. ½ lb. seam composition or putty. ½ pt. "C" quality marine glue. Strips of cloth.

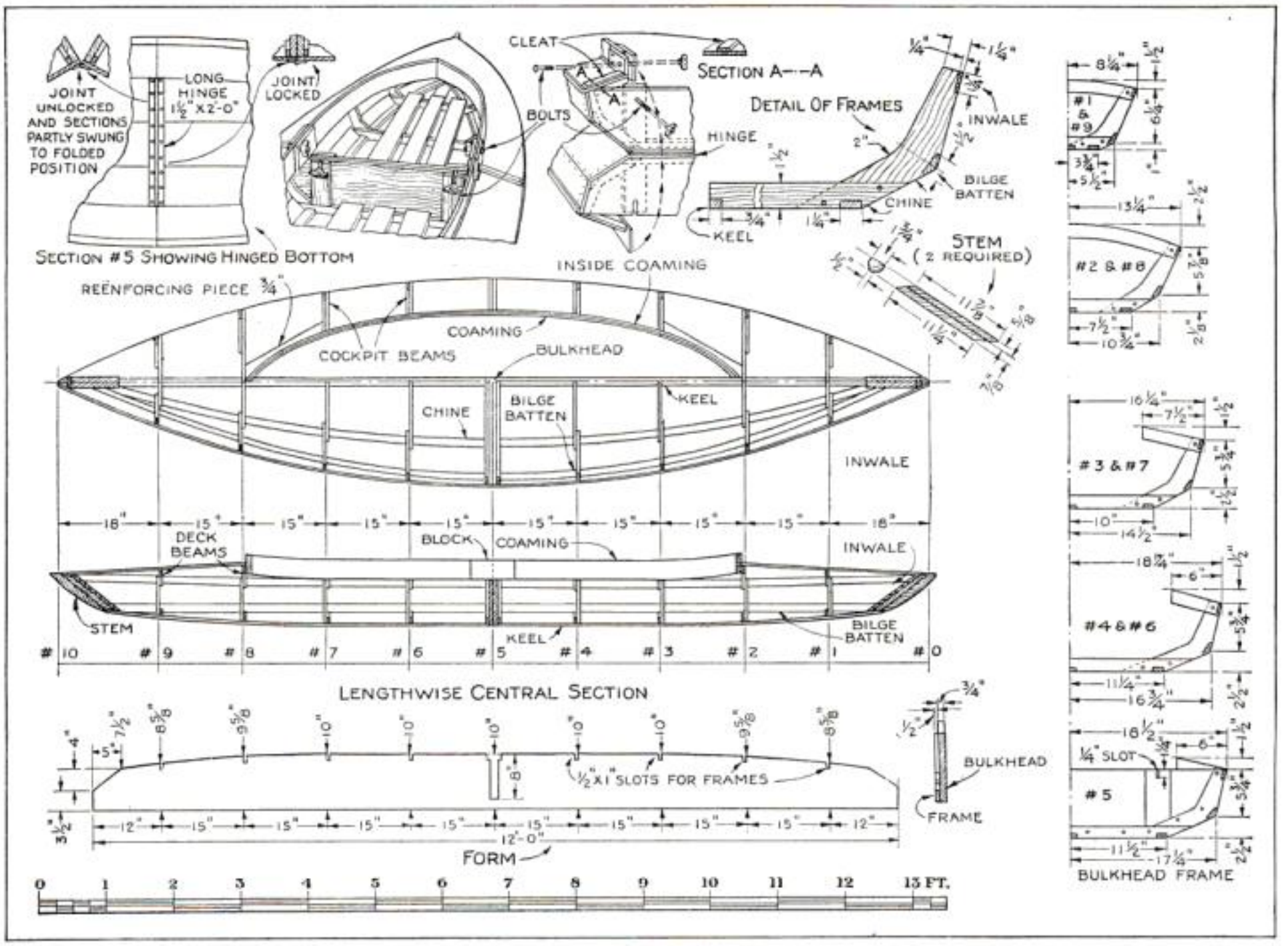
Stretch canvas tightly and smoothly over the deck and side deck, and tack it to the outside edge and coaming with ½-in. tacks. Trim the canvas off, and fasten the 5/16 by 3½ in. outside coaming to the inside coaming with 1-in. No. 7 screws spaced about 4 in. apart. Fasten a small beveled block in the end of the coaming to hold the edges together.

A false outer stem of oak, sawn in a curve, is now fastened to the stem with four 1¾-in. No. 8 screws. The ¾-in. half-round molding is added next.

The long hinge is fastened to the two bottom sections with 1¾-in. No. 8 screws. Fasten blocks on each side of the coaming as shown so that when the boat is to be used ¼ by 1¼ in. carriage bolts can be inserted and fastened with wing nuts. At each side of one of the center bulkheads a ¼-in. hole is bored, while in the other bulkhead a corresponding ¼-in. slot is cut. This is so a ¼ by 2 in. carriage bolt will project through the one bulkhead, and will fit in the slot in the other bulkhead.

The floor boards can be removable or fastened to the frames with screws.

Calk the bottom planks with wicking, and putty all seams and screw holes with seam composition or putty. Apply three or four coats of paint to the entire hull. For hunting use, paint the hull a dead grass color.



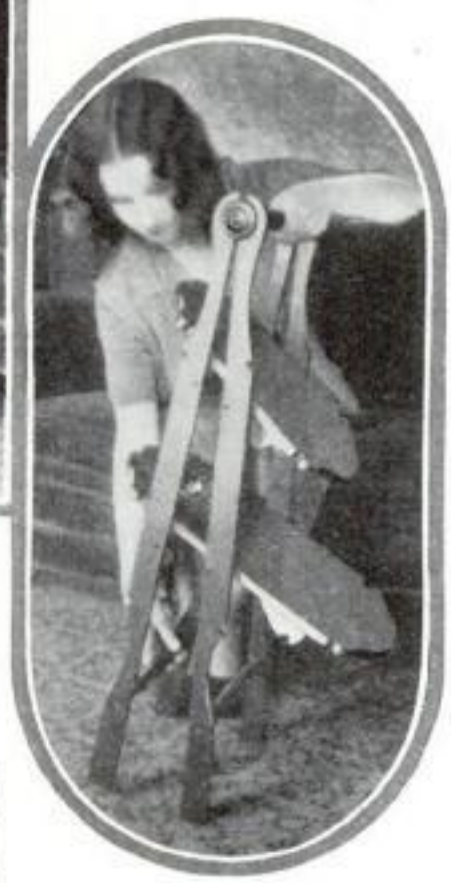
Assembly drawings of the duck boat, the form on which it is built, and details of frames, hinged joint, and other parts. Larger views are given on Blueprint No. 170 (see page 108)

HOW TO CONSTRUCT A UNIQUE

Folding Muffin Stand

By E. C. Wittick

School of Education, University of Chicago



The legs of the muffin stand are hinged with a simple type of rule joint which makes it possible to fold up the piece compactly for storing it away

HERE is an unusual and decorative folding muffin stand or double-deck serving table, the construction of which will delight the heart of any home woodworker and add another new and useful piece of furniture to the household. The hinge joint at the top is of unique design. The legs and shelf ends are typical of the Colonial period, but the design could easily be changed to modernistic.

White pine finished in walnut was used in the piece shown in the photographs, and it was found satisfactory on account of its lightness. Any good cabinet wood could be used; birch is excellent since it will take a maple, mahogany, or walnut finish.

In the accompanying list of materials, the exact sizes are given except for the turned pieces, where allowances have been made for the ends and for truing up.

Make the legs first by planing the four pieces smooth and clamping them together as shown in detail *A*, using a hand screw in the middle so that all the holes and curves can be laid out at once. Drill them while the pieces are still clamped. When boring the 5/8-in. hole at the hinge joint, hold the pieces by the edges in a vise.

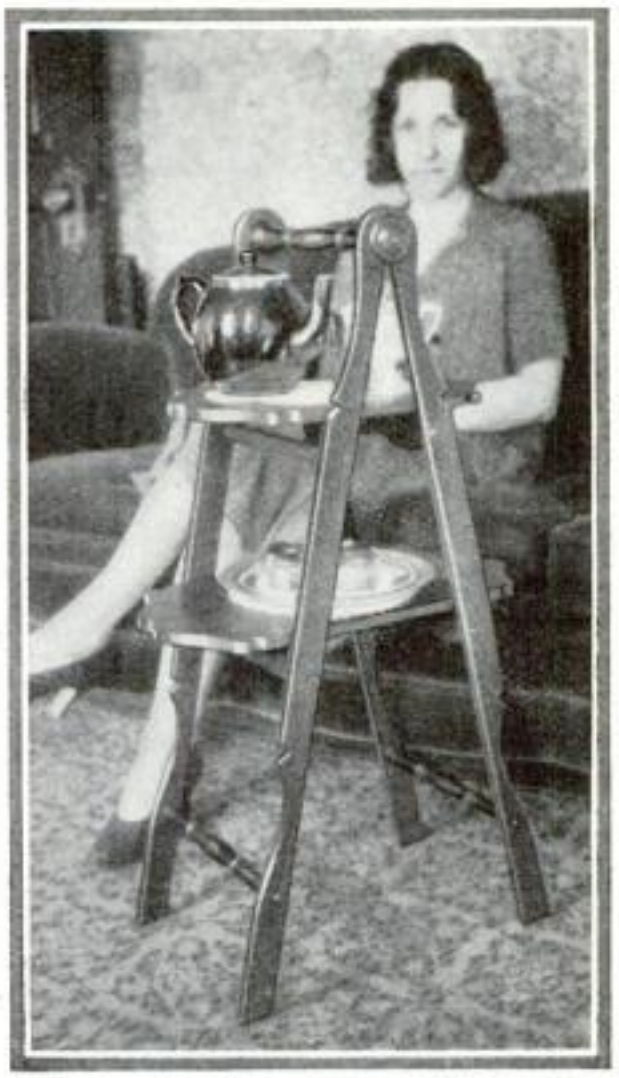
The V-cut at the top, to allow for hinge swing, should not be made until after the circular groove cut by the tool shown in detail *M* has been made. This will avoid splintering. After the 5/8-in. hole has been bored, remove the hand screw.

The cutting of the circular groove on one side of each pair of legs is a simple job with tool *M*. The method is illustrated in one of the sketches. The cutter *M* is made by turning a V-cut of 1¼ in. diameter in the face of the end of the tool in which to locate accurately the drill holes for the wood screws which form the cutters.

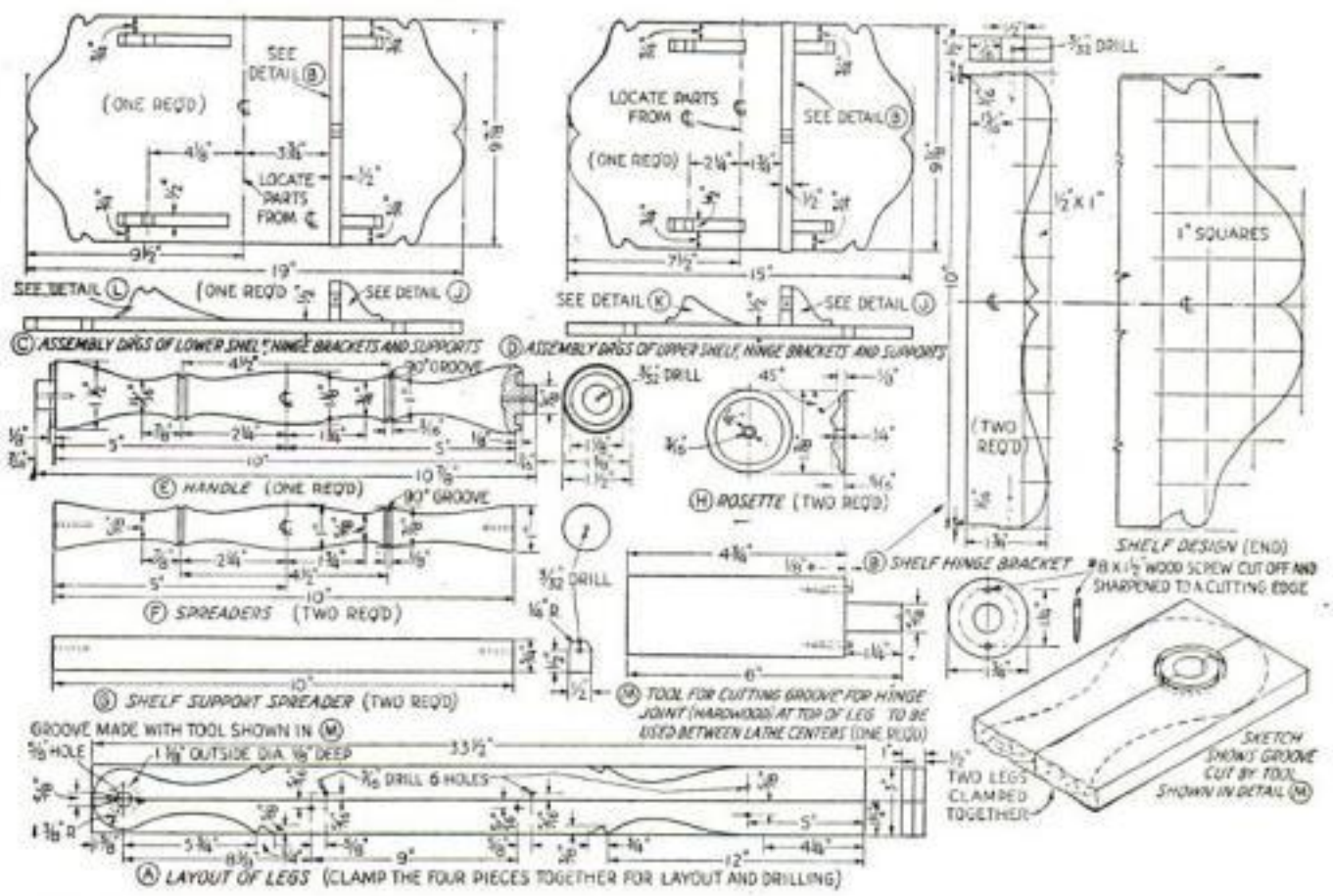
With the circular grooves finished, the V-cut at the top of the legs may be made by planing each piece separately to the line as laid out at the start; then the curved outlines may be jig-sawed and filed and sanded smooth.

Next the handle should be turned and fitted to the circular grooves; then the rosettes. The handle and legs are now ready to be assembled and tested for the spread of 16 in. as shown in the assembly drawing. The lower spreaders should then be turned and installed.

The laying out and cutting of the shelves, shelf support spreaders, and brackets need no special explanation except that the work on the hinge brackets and supports must follow dimensions very accurately or the shelves will neither set level nor fold properly. The hinge brackets and supports in the stand shown in the photographs were fastened to the shelves with hot glue and brads. Screws are preferable and *(Continued on page 107)*



This portable little muffin stand is useful, decorative, and distinctly unusual in design



Working drawings of the shelves, legs, handle, turned spreaders, and shelf support spreaders, and a special homemade tool for cutting the grooves in the legs. See page 107 for assembly drawings

TENT

Prize Winning Plans Show How to Construct Folding Canvas Camps

Compactness on the road and roominess when set up make the folding tent trailer ideal for the small family. If desired, a small boat can be carried on top of the folded trailer body

FOR the auto camper who desires maximum comfort at minimum cost, the so-called "tent trailer" offers many advantages. It is in reality an inexpensive portable camp, which can be quickly expanded by setting up a canvas roof and walls.

Two ingenious designs for this class of trailer were awarded prizes in our recent camping car contest, the winners of which were announced in a previous issue (P.S. M., May '32, p. 73).

The simple construction, completeness, and portability of tent trailers is clearly shown in the drawings entered by Andrew Mazur, of Monessen, Pa., who places the cost of construction at $74.45. The more important details were described in the following letter which accompanied Mr. Mazur's entry:

"The running gear used is from a 1925 Chevrolet, the springs being attached to the main body by four sets of plates. The back ends of the springs have the usual hangers to allow expansion.

"The coupler is bolted to a stud and held by two straps fastened to the body with lag screws. A piece of rubber tire casing, placed between the joints of the coupling, prevents the noise that is common with many trailers.

"Pockets for the four removable legs are made from strap iron and are fastened to the body with lag screws.

"Two braces are hinged to each side of the body and the top of the door frame, which is made of 2 by 2 in. stock. The upper part of the door, which is screened, is bolted to the lower door. The body framework is 2 by 4 in. studding.

"The elevated floor frames are made of 2 by 2 in. material and are floored with ceiling boards. Two suspension cables support the outer edge of each floor and four butts [hinges] support the inner edge. When the floors are closed, they rest on two corner irons fastened inside the body.

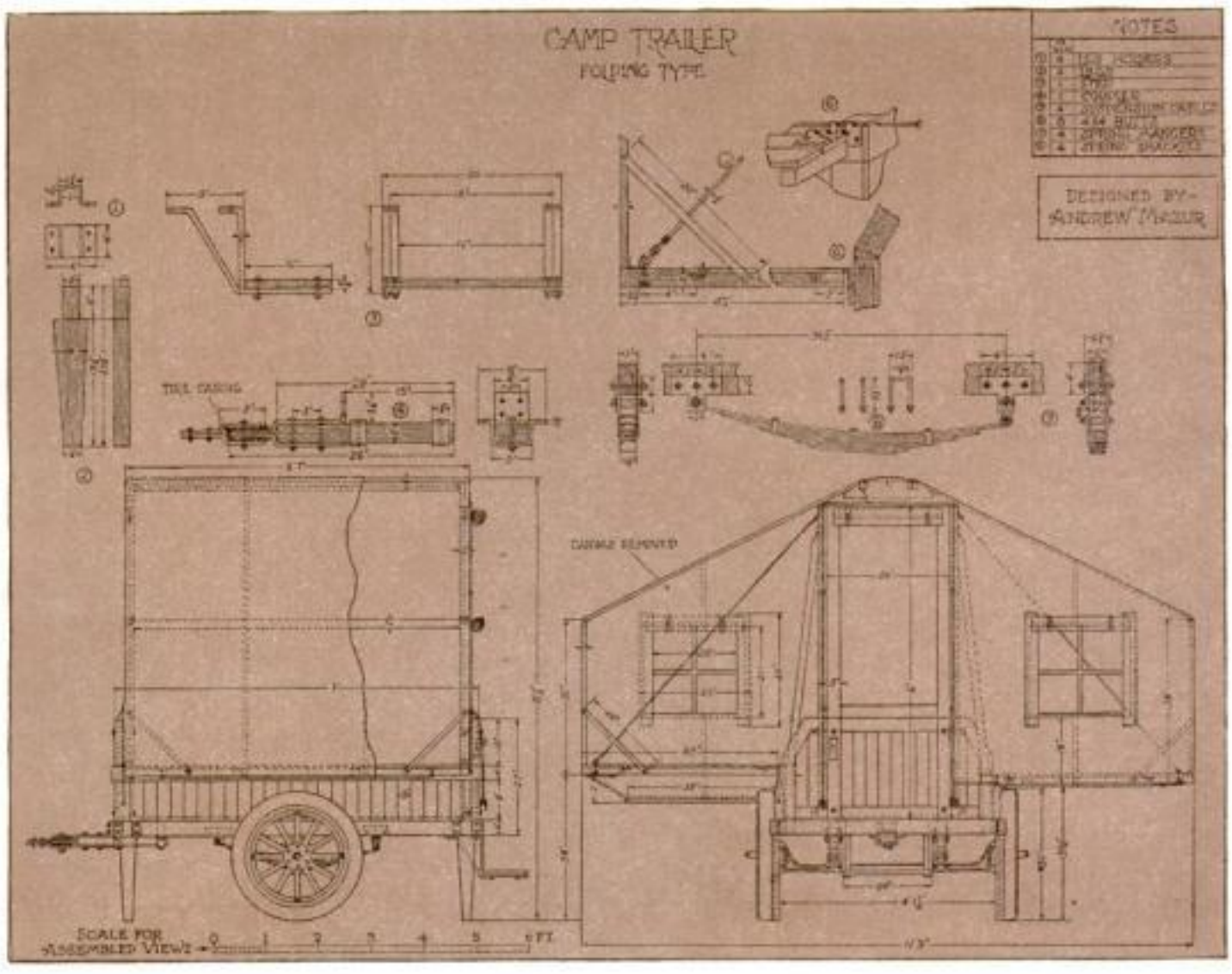
"Small butts with easily-removed nails replacing the pins are used at the joints of the top frame, which is 1 by 2 in. stock, to allow easy assembling. The vertical members on the elevated floors are braced at the corners. One end of each brace has a catch, which on assembling engages with a screw driven into the edge of the floor.

"Friction catches serve to hold the canvas top in place around the door opening. The bottom edge of each wall is held securely by means of lines looped through eyes on the bottom sides of the opened floors.

"The windows, which are copper screened, fit into pockets in the wall. Canvas curtains, which can be rolled and held with straps when not in use, cover the door and windows.

"When folded, the interior of the trailer body serves as a storage place for the top and all camping equipment.

"Itemized cost: Running gear (second hand) including welding, $7; spring holders, $2.50; leg pockets, $1; coupling straps, 50¢; coupling, $1.20; steps, $1; braces, 50¢; wire clamps, 60¢; steel rope, $2; hooks, 50¢; lag screws, nails, and



These are the original tent trailer drawings as submitted by Andrew Mazur, of Monessen, Pa. When packed for touring, the trailer body measures approximately 3 ft. 10 in. high, 4 ft. wide, and 7 ft. long

TRAILER Combines Comfort and Low Cost....

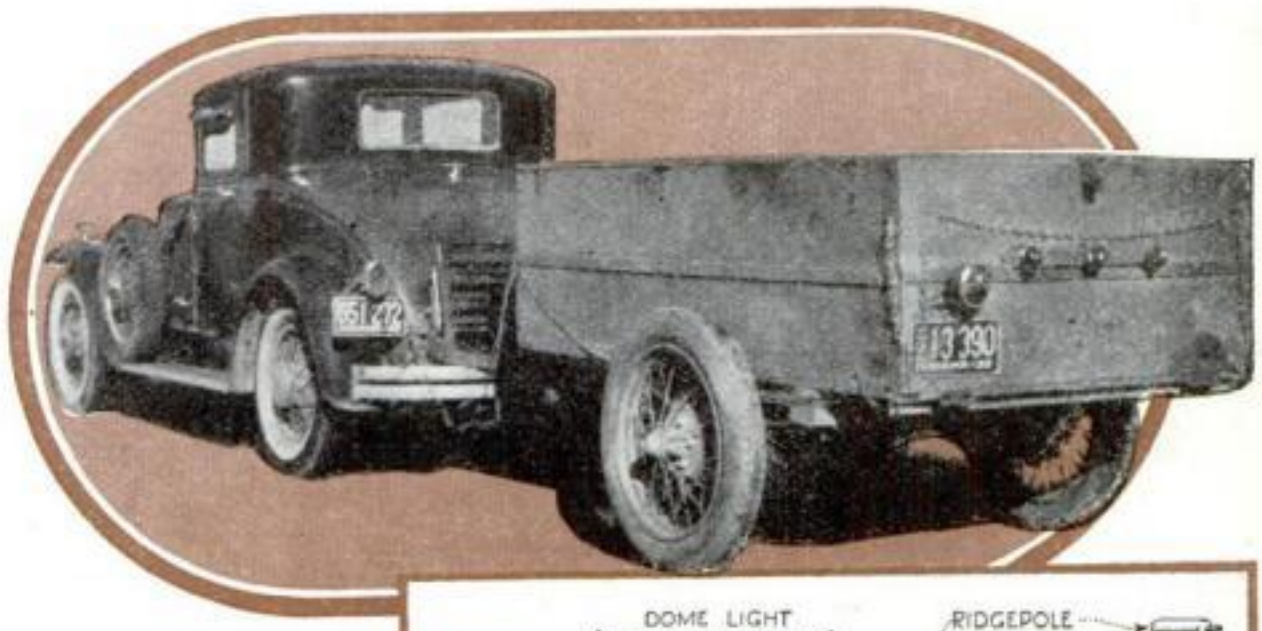
screws, 80¢; washers and bolts, 60¢; butts, $4.40; rope hangers, 40¢; sash cord, 25¢; friction catches, 10¢; lock, 50¢; corner irons, 75¢; S-hooks, 20¢; copper screening, $1.20; eyebolts, 40¢; cord retainers, 30¢; straps, $1.10; canvas top, $24; lumber, $20.65; paint, $2."

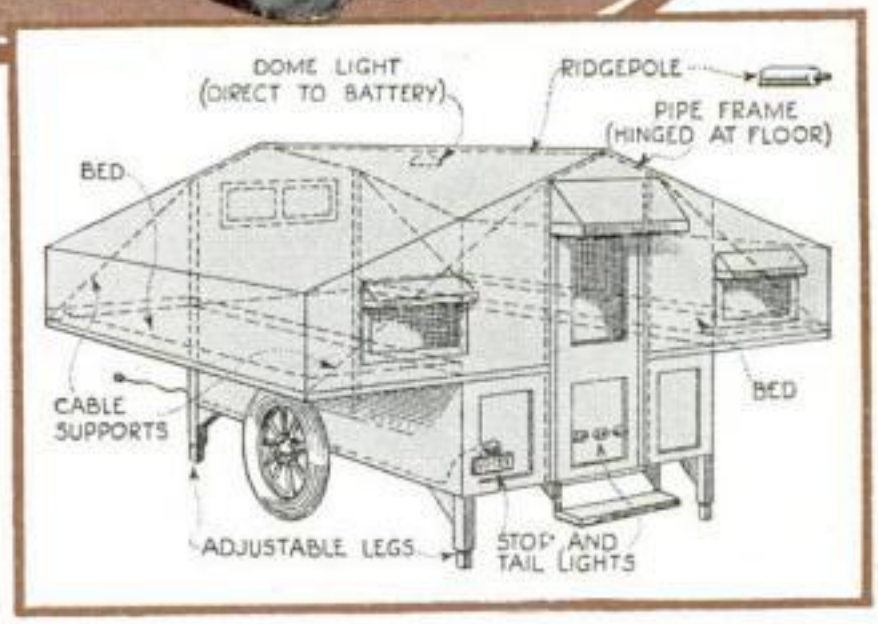
The compactness with which the top of the tent type of trailer can be stowed away for traveling can be seen in the photographs of another prize winning tent trailer designed by Robert Dougherty, of Whiting, Ind. In this trailer, the designer has incorporated electric lights, refrigerator, pantry, and adjustable legs. In describing his trailer Mr. Dougherty wrote as follows:

"This trailer doesn't hamper speed, is safe, comfortable, quickly assembled, and the entire equipment can be removed quickly, leaving the equivalent of a light truck which can be used for many purposes while not on the road. It will perform as well as many other trailers and can be built at a fraction of the cost. Using odds and ends of scrap materials as I have done, it can be constructed for $50 or less (not including the mattresses.)

"The chassis, salvaged from junk, cost me nothing. The trailer springs and mountings were purchased for $8, but in many cases they also can be obtained from a junk heap.

"Using pine, the body of the trailer, which is of simple construction, cost me less than $12 complete. In order to obtain additional strength along the sills and four corners, I used angle iron. Ordinary





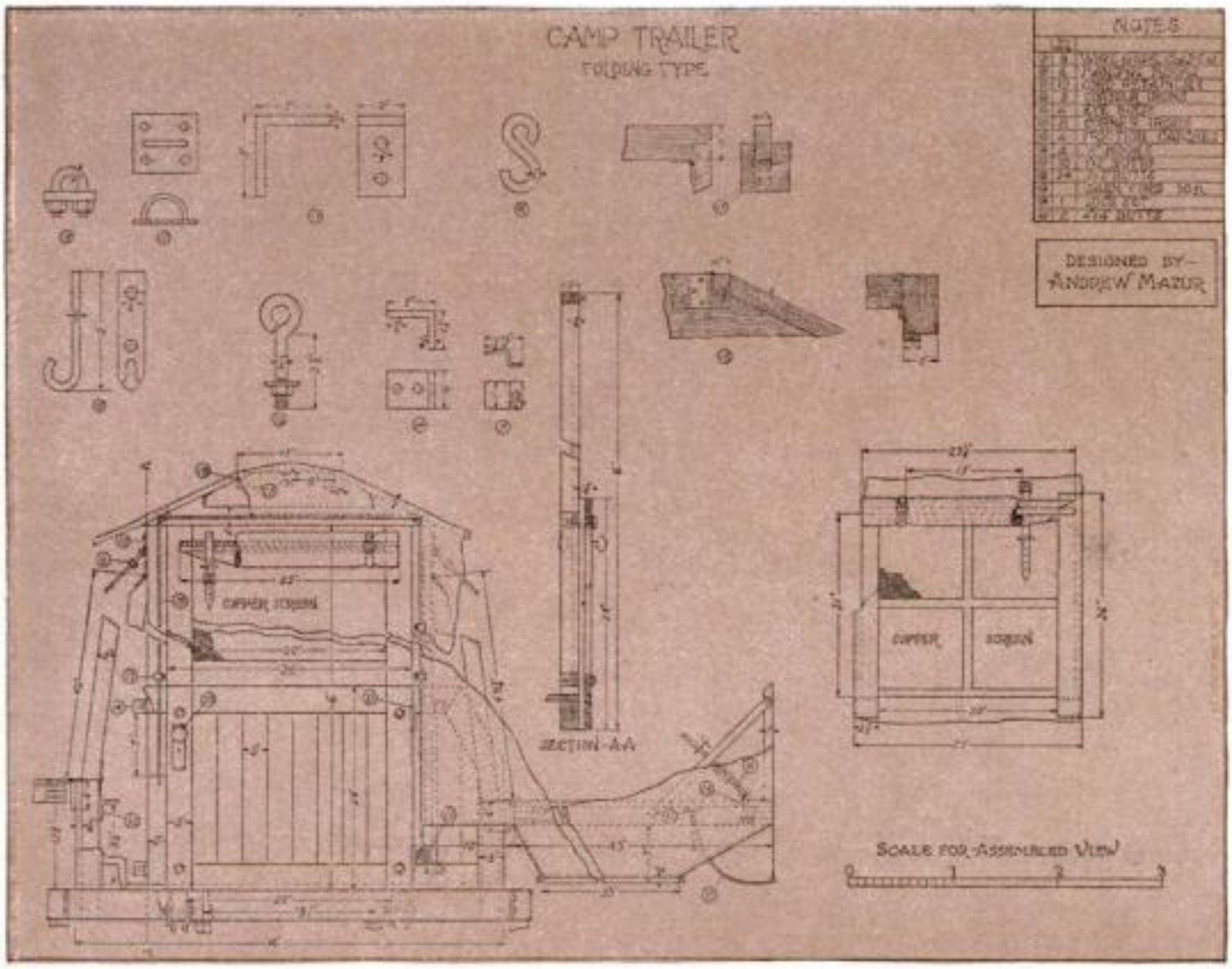
Mr. Dougherty's trailer packed up for the road and a sketch showing the canvas top opened. This trailer has been tested at 70 M. P. H.

floor board stock was used for the floor. As shown in the drawings, the stop light and tail lights were wired to the car.

"Observation and experience have shown me that the weakest part of the homemade trailer is the method of coupling it to the car. For the coupler on this trailer I used the universal joint on the original chassis. I have found it highly satisfactory under all conditions —the trailer swinging out and following directly in the tracks of the car, thus reducing the danger on sharp turns. The coupler is fastened to a frame which projects at the back of the car. I have pulled this trailer at 70 M. P. H., making but one set of tracks.

"Anyone can build this trailer on the unit plan during his spare time as I have done and am doing. Depending on the individual, equipment may be either simple or elaborate. I plan the addition of a pantry in the front end."

The body of Mr. Dougherty's trailer, when closed for touring as shown in the photograph, is 7 ft. long, 4 ft. 1 in. wide, and 2 ft. high.



If you wish to build a trailer like Mr. Mazur's, you can obtain two blueprints made from his original drawings by sending 75 cents for special blueprints Nos. 171A and 172A. Drawings of a trailer of the collapsible type (P. S. M., May '32, p. 73) can be obtained by sending 50 cents for special blueprint No. 167A. An order coupon is given on page 108.

SHORT CUTS

That Aid All Car Workers

Fig. 1. Potassium chlorate crystals, clinging to spark plug, remove carbon when plug is heated

WIN A $10 PRIZE

Each month we award $10 for the best idea sent in for motorists. This month's prize goes to Addison Shiek, Oakland, Calif. (Fig. 1). Contributions are requested from auto mechanics, and if printed will be paid for at usual rates.

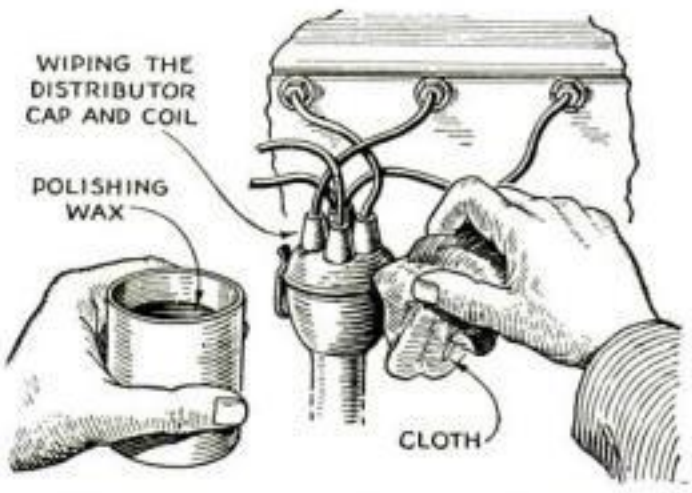


Fig. 4. Keep the distributor head clean and rain can't form a short-circuiting film there

SCRAPING the carbon from the shell that surrounds the center electrode of a spark plug is difficult. However, it can be removed easily with a small quantity of potassium chlorate crystals. Get an ounce or two of this chemical from the drug store, then heat the plug over the gas stove (firing side down) till potassium chlorate, sprinkled over the electrodes and insulator, melts and sticks. Heat again until there is a distinct puff caused by the sudden oxidization of all the carbon by the oxygen from the chlorate. The latter is reduced to potassium chloride, which can be dissolved in plain water. After heating to dry out the moisture, the plug will be ready for service. The heat developed by the sudden combustion of the carbon will not harm the plug.

To Tighten Spokes

AFTER years of service, especially in dry climates, the wood spokes of auto wheels become loose and cause creaking noises. Figure 2 shows a way to tighten them. Dismount the wheel by removing the flanges, then cut and punch soft sheet copper, as shown, to form washers which will fit over the ends of the spokes. This arrangement takes up both the looseness between the shoulder of the spoke and the steel rim and also that of the stud in the hole.

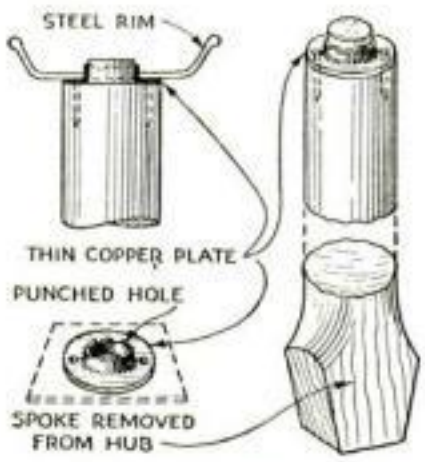


Fig. 2. Loose spokes in wood wheels can be tightened with sheet copper as diagram shows

Stopping a Rattle

WHEN the leather hood lacing, which prevents metal to metal contact between the radiator shell and the edge on the cowl against the hood, becomes worn, rattles develop. A quick cure, if new lacing is not available, is shown in Fig. 3. Cut flat washers from a rubber cork such as used with household ammonia bottles. Countersink them with a drill or penknife and fasten at intervals with a split rivet or paper fastener.

Leaking Current

RAIN water puts the auto ignition system out of commission by forming a film of moisture over the distributor head and thus causing current leakage from the high tension spark plug wires. This trouble is most likely to occur if the distributor head is coated with a film of grime. If the distributor and the wires leading to it are given an occasional thorough polishing with any good auto body wax, rain will roll off, not form a short-circuiting film.

Support for Head

WORKING beneath the car gives most men a pain in the neck. Figure 5 shows a form of rest that fastens to the head so it is always in place no matter how much you move about under the car. It is a sure cure for this particular form of pain in the neck. The rest should be bent to shape from heavy wire and a canvas or khaki pad fitted across the top. An elastic band cut from a large inner tube serves to hold it in place or if no tube is available, a canvas or leather strap can be attached by means of short pieces of inner tube to provide the necessary tension.

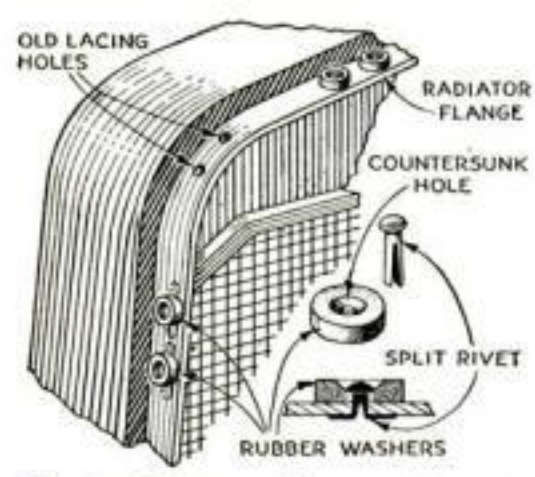


Fig. 3. Washers cut from a rubber cork can be used to prevent the rattle caused by the radiator shell striking the hood

Warns Against Thief

ANOTHER variation of the auto horn thief warning idea is shown in Fig. 6. Instead of hooking the horn circuit so that it blows when the ignition switch is turned on, this arrangement blows the horn when the intruder sits in the driver's seat, and continues to blow until he gets out of the car. The secret switch under the dash puts the circuit out of use while the owner is using the car.

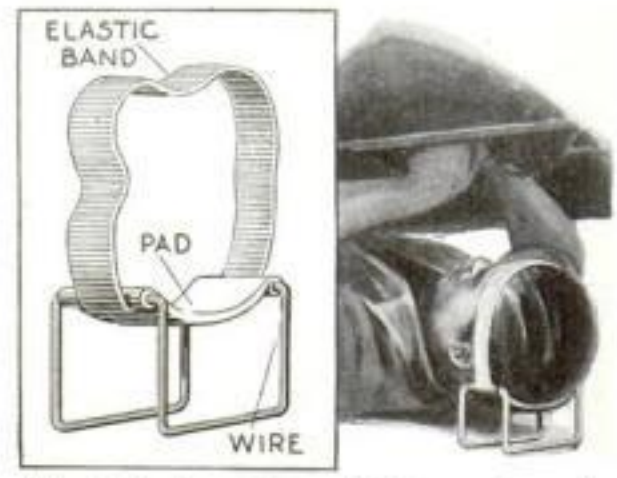


Fig. 5. Head rest, formed of heavy wire and elastic band, helps when working beneath car

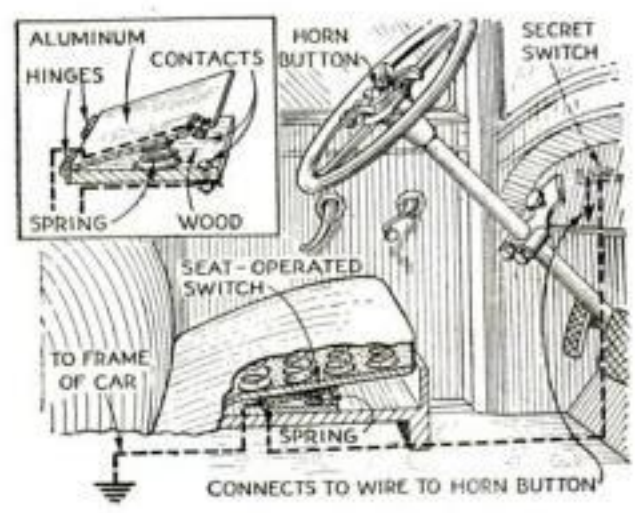


Fig. 6. Secret switch under driver's seat starts horn blowing when thief tries to steal your car

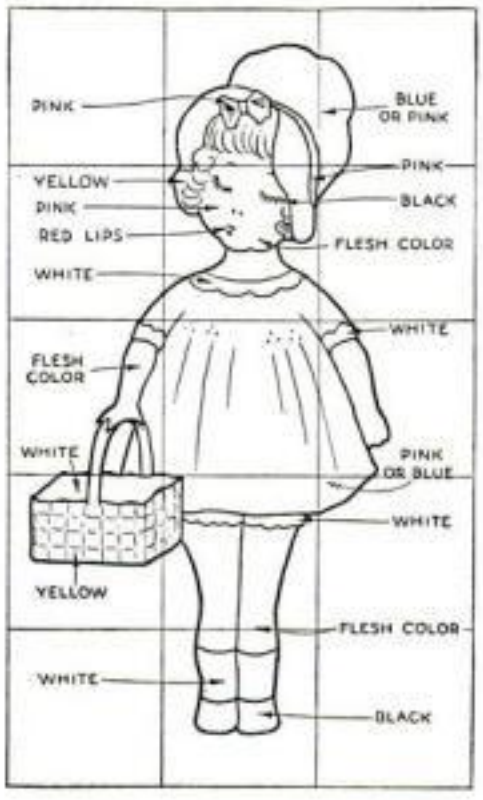
Unique Jig-Sawed Dolls Hold Back Nursery Curtains

WINDOWS and their accessories play an important part in a child's room. Dainty ruffled curtains, for example, are more attractive if gracefully draped and held back by colorful little figures like those illustrated.

Such figures may be sawed from ½-in. wood and should, of course, be made in pairs, each about 9 in. high. Prepare a cardboard pattern of the figure and trace around it on the wood. Cut out the pieces, file the rough edges, and sandpaper them smooth. The wood may be painted with either enamel, lacquer, or oil paints. Any color may be used, though pink and blue seems most fitting for the nursery. All outlining should be done in black.

As a support for each tie-back, cut a strip of tin 1¼ by 6 in. and bend over both sides of strip for about ¼ in. to insure against sharp edges. Fasten the tin strip to the back of the figure with two screws, then bend the metal slightly U-shaped and fasten the other end with two screws to the window casing.—KATHLEEN LITTLE.

A pattern for sawing out these novel tie-backs can be made by drawing fifteen 2-in. squares on paper and copying the figure below



The curtain is draped behind the tie-back where it is held by the tin strip with which the wooden figure is attached to the window casing. This strip is like a U set horizontally. The figures should be made in pairs, one right and one left

Merely by putting the dicebox up to his eye, the performer is able to tell which number is uppermost. The box is made by cementing strips of celluloid together as indicated below

CHINESE DICEBOX MYSTERY

A CHINAMAN of ancient times is supposed to have invented this dicebox mystery for the entertainment of his twelve wives. Essentially it consists of a celluloid box and a die that fits the box exactly. No matter who places the die in the box or what number is uppermost, the performer can name the number merely by holding the box to his forehead. Of course, close examination of die and box reveals nothing to the spectators.

The die is quite ordinary, and the box is made from celluloid obtained by cutting apart a composition toy of one of the various kinds sold in ten-cent stores. Even a baby's celluloid rattle will do. Cut the material into strips and shape it around the die, cementing the joints with household cement or acetone. Hold the parts in place with a pair of tweezers while the cement is drying. Make the lid in the same manner. The method of construction can be clearly seen in one of the photographs.

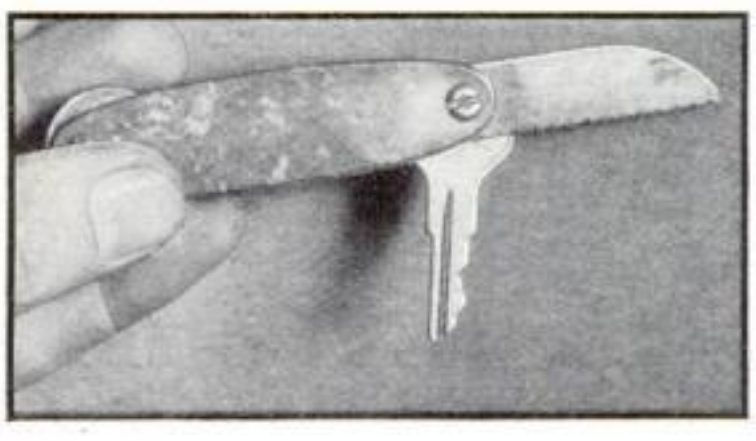
The secret lies in the fact that both the lid and sides of the box are made of a double thickness of celluloid, while the bottom is but one thickness.

In picking up the box, the performer squeezes it so that the die remains on the bottom. By glancing at the bottom as he places the box to his forehead, he can see the spots through the single thickness of celluloid. This number of spots is subtracted from seven, which reveals the number of spots on the top of the die. When a spectator looks at the underside, he does not squeeze the sides, therefore the die falls away from the bottom and nothing is revealed.—KENNETH MURRAY.

POCKET HACK SAW HELPS IN DOING ODD JOBS

YOU will find many uses for a tiny hack saw that can be carried in your pocket as part of a key holder or knife. It will come in handy when you are making some minor repair on your automobile, working with camp equipment, or doing a bit of home tinkering.

The pocket hack saw is nothing more than part of a standard hack saw blade shaped to serve as an extra blade in a pocketknife or mounted in a key container of the type illustrated. The length of the finished saw will depend on the size of the holder, but 2 in. is sufficient. If the blade is hardened only along the cutting edge, it can be shaped with a pair of tin snips; otherwise grinding is the best method. Usually the teeth near the ends of an old blade remain sharp enough to be converted for pocket use, so that you need not spoil a new blade. A saw blade ½ in. wide will prove most easily adapted to the average size key container or small pocketknife.—VERNON B. CASE.



Boy's Raft Floats on Four Large Malted Milk Cans

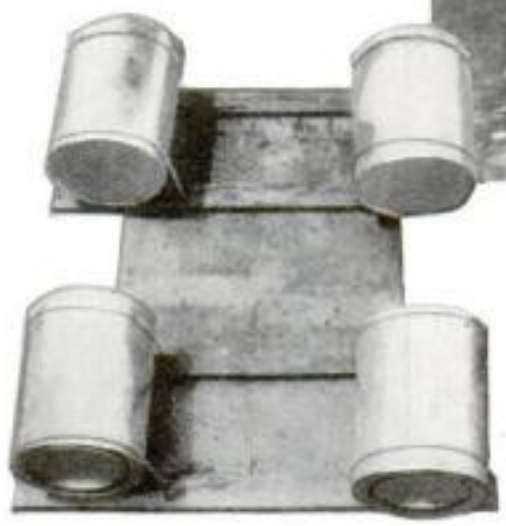
A LIGHT platform mounted on four large malted milk cans makes a safe and inexpensive raft for pond or swimming pool. These cans generally can be had for the asking from your neighborhood druggist. It is quite possible, too, that other types of cans could be obtained which would serve the purpose equally well. Wash them out thoroughly. When they are absolutely dry, apply shellac around the edges of the compression lids, allow the shellac to become somewhat gummy, then force the lids into the cans as tightly as possible and apply another coat of shellac around the rim. This will seal the cans and make them water-tight.

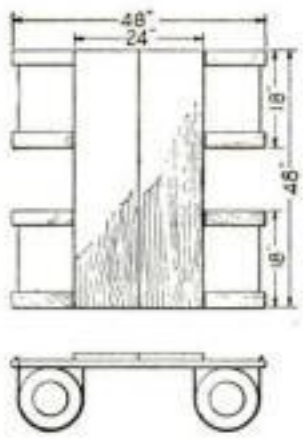
Build a platform as shown in the accompanying drawings. For this you will need two boards ¾ by 12 in. by 4 ft. and four cross members ¾ by 3 in., also 4 ft. long. The cans are secured to the crosspieces with loops of galvanized bailing wire passed through holes in the wood as shown. Twist the ends together and bend them down so they will not catch in the clothing.

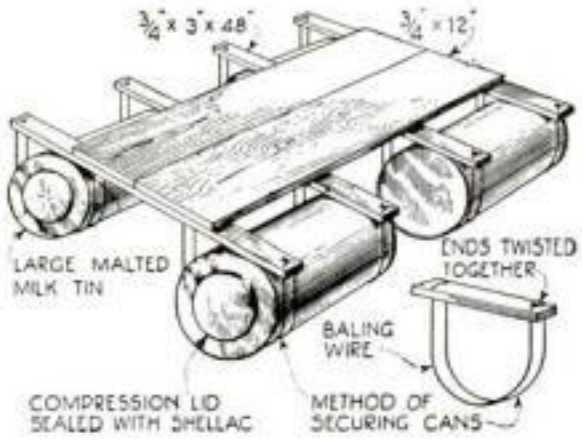
This raft is light enough for a husky boy to portage from one pool to another. It is not, however, designed for use in rough water.—HI SIBLEY, JR.

Nothing appeals more to a boy's sense of adventure than having a raft on which to paddle around a pond, even if no larger than a swimming pool

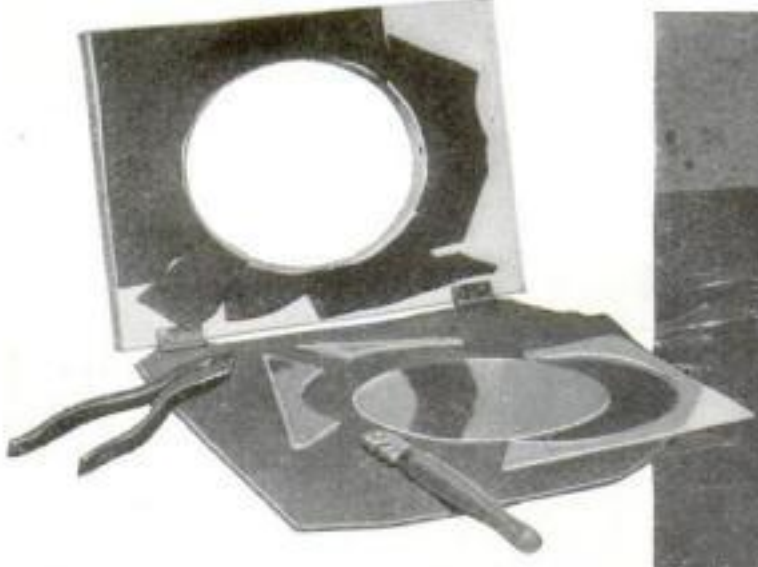
The photograph below shows how the malted milk cans are fastened with loops of wire to the raft platform







The top and end views of the raft, together with a perspective assembly drawing, are given at the right



The wooden template, well padded with felt, is placed over the glass, and the cutter is guided steadily around it with even pressure

CUTTING ODD SHAPES FROM GLASS

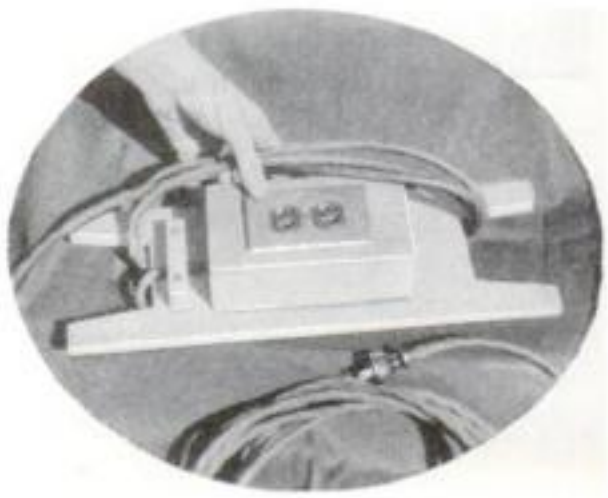
WHEN a professional glazer skillfully guides his hissing tool free-hand around a line and produces a flawless piece of work, it appears quite simple—until one tries to do the same. Circular, oval, and odd-shaped glasses for picture frames, clock faces, and the like can be cut easily, however, by the method illustrated above.

Obtain a piece of ½-in. wood somewhat larger than the glass desired. Pine will do if only one or two glasses are needed, but maple is better if it is to be a stock pattern. Draw the pattern and cut it out with a scroll saw. Sand the edges until the glass cutter will glide around the entire circumference without snagging. Cover the underside of the pattern with scraps of felt from an old hat. Make a pad of felt or other soft material for the top of the bench or worktable. Hinge the pattern to the table, making an allowance for the thickness of the glass.

With the glass in place, lower the pattern and hold it firmly with the left hand. Grasp the cutter vertically in the right hand and guide it around the edge of the pattern with a steady motion and constant pressure. Do not lift the cutter until the entire piece has been cut. If this is done correctly, the waste stock may be broken away with the fingers. If there is considerable waste, it can be removed more easily after radial lines have been scratched across it, but never let the cutter come clear to the edge or the entire piece is likely to be shattered. If any tiny pieces do not break away, snip them off with pliers.—ALEXANDER MAXWELL.

BAMBOO LETTERING PENS

AT VARIOUS times I have been called upon to make posters with considerable lettering. This work has been greatly simplified by the use of homemade lettering pens. To make these, I split a 6-in. length of bamboo into widths suitable for the lettering, and then whittle the ends flat.—M. L. ABELE, Lieut. (J. G.), U. S. Navy.



HANDY EXTENSION CORD FOR HOUSEHOLD USE

AMATEUR mechanics and electricians will find the portable receptacle shown above a convenience where long extension cords are brought into use. This "carryall" was made from a flat board 6 by 18 in., with a 3 in. deep notch cut in each end so that the cord could be wound on. Nailed to the board is a wooden box, 2½ by 4 by 7 in., containing an electrical outlet for other extensions. The extension cord may be wound on the board and carried easily.—ORMAL I. SPRUNGMAN.

Rigging *the Wanderer*

HOW TO SET UP THE MASTS, YARDS, BOWSPRIT, AND JIB BOOM OF OUR WHALER MODEL

By Capt. E. Armitage McCann

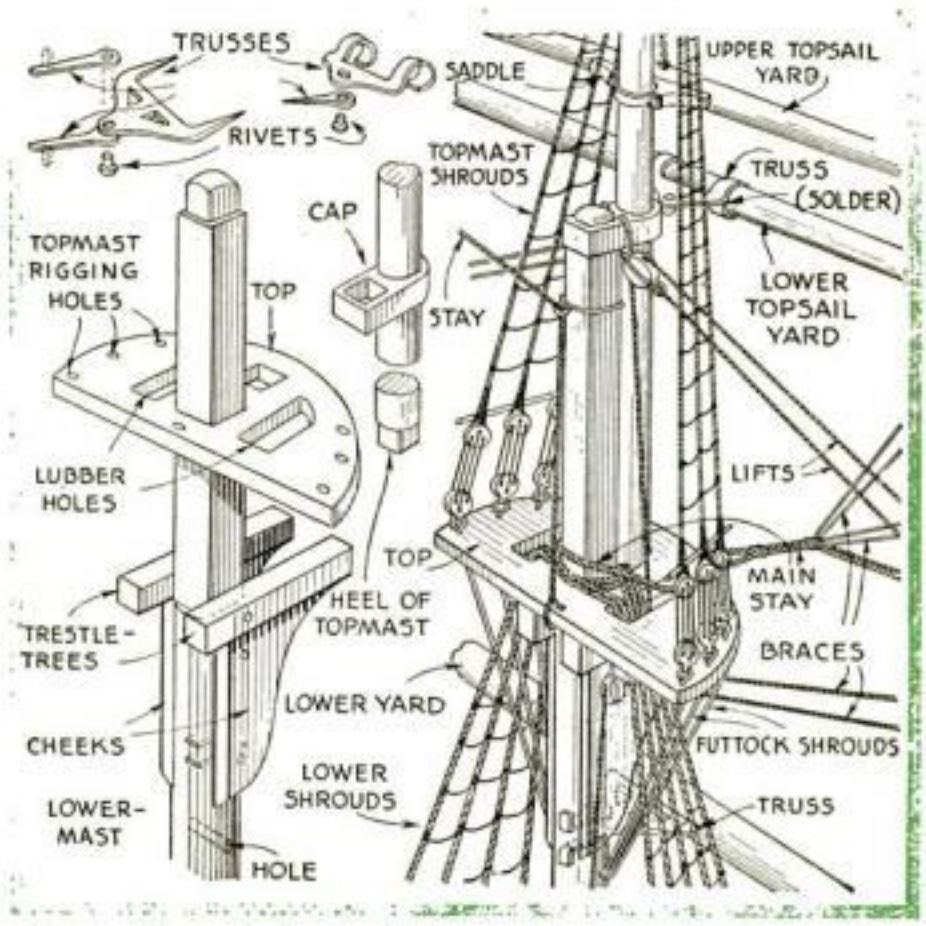
This model of a whaling bark is more than a mere decoration—it is the picturesque symbol of a bold-hearted race of American seamen

IN THE April and May issues we described the hull and deck fittings of our 1/6 in. scale model of the whaling bark *Wanderer*. This has been done in considerable detail because I was able to take a number of snapshots and measurements aboard her before she started on her last voyage. And that voyage marked the final chapter in the heroic story of American whaling ships. The *Wanderer* was the last of a long line of New England whalers in active service.

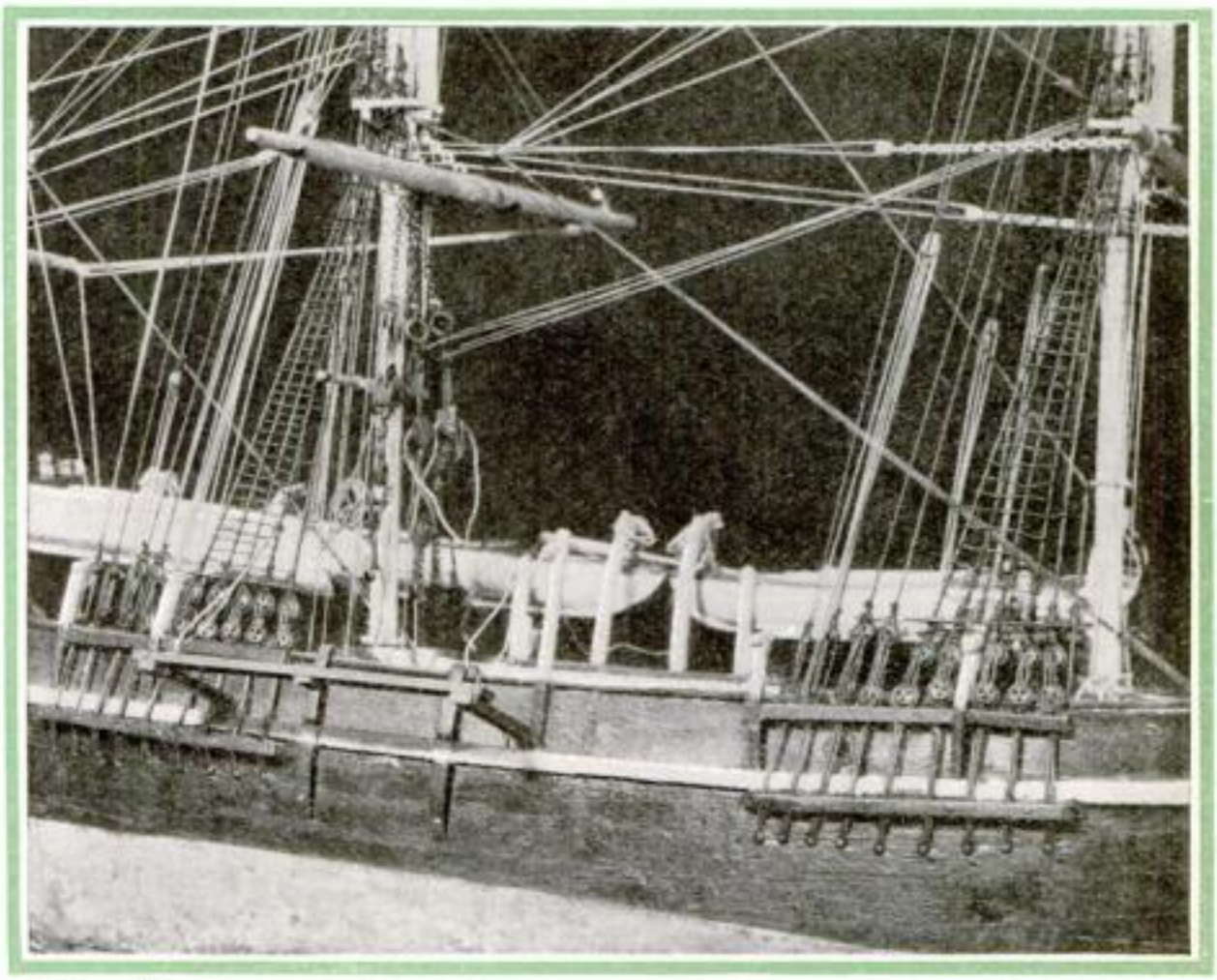
If you intend to build this exceedingly decorative model and have not already begun, you should send one dollar for POPULAR SCIENCE MONTHLY Blueprints Nos. 151, 152, 153, and 154, which give full size drawings of both hull and rigging (see page 108). To make the work still easier, the Popular Science Homecraft Guild has assembled kits containing all the necessary materials for building the model except the paints. These kits are reasonably priced and the materials are of the highest grade and carefully selected for this special purpose. To obtain one of the kits, use the coupon on page 109.

The next work to be done on the model is the shaping of the spars from round dowel sticks. The dimensions of all the spars can be taken from the blueprints.

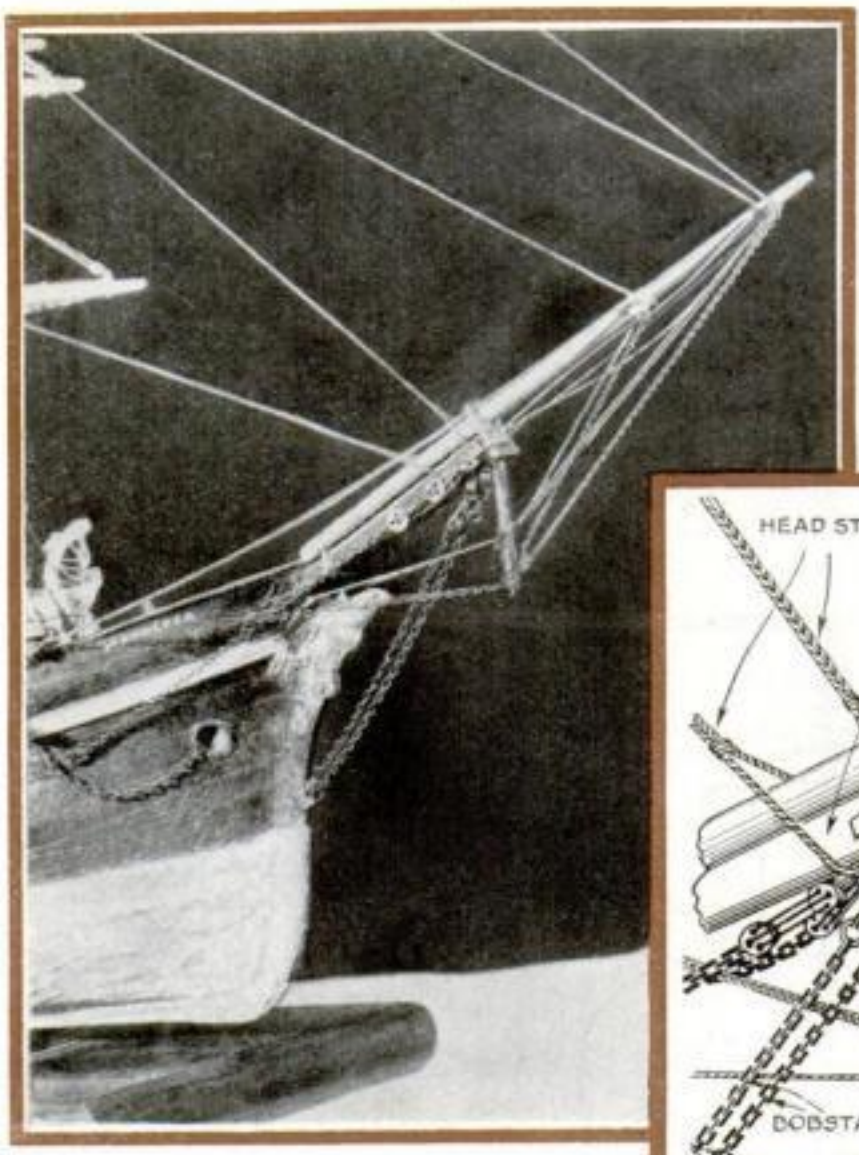
The lowermasts are round to the caps, except where their sides are flattened underneath the caps to take the cheeks and trestletrees, which should be firmly nailed on. Above the tops they are square, with smaller squares for the caps. The tops are half-round with square holes for the heel of the topmasts and the heads of the lowermasts. They can be made of wood or celluloid. The oblong holes (lubber's holes) are for the rigging to pass through. There are three holes on each side for the rigging. The caps are square abaft and round in front. At the mizzen there are only trestletrees and crosstrees.



How to fit the cheeks, trestletrees, top, and cap to a mast, and details of trusses, saddles, and rigging adjacent to the mast top

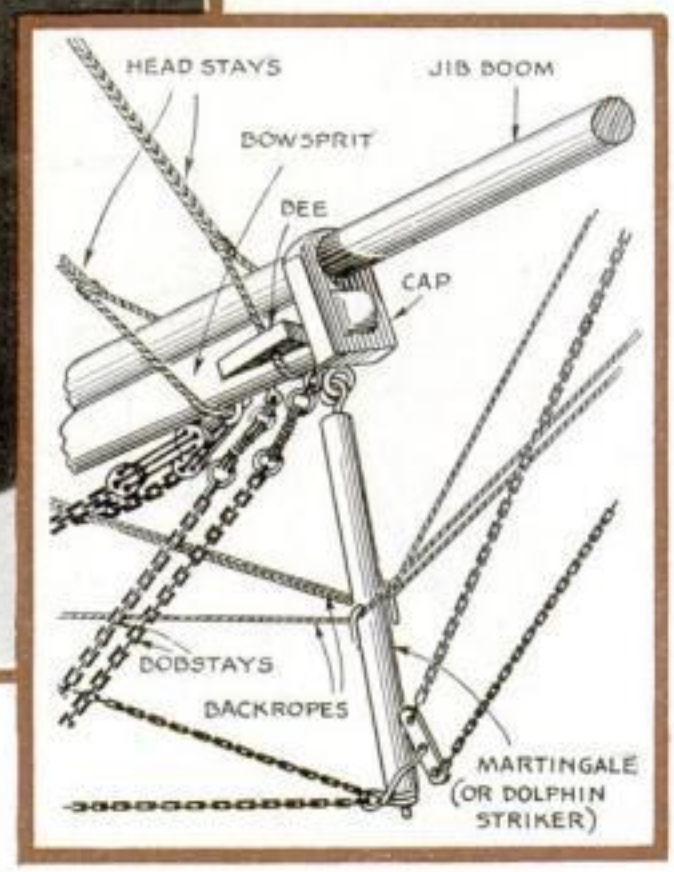


This striking photograph of Capt. McCann's model shows how realistic the rigging is. Strive for the same effect in your own model. The blueprints necessarily show the rigging in a somewhat stiff and conventional way, so study the photographs to learn the seaman's touch



Here again the skill of a master model maker can be studied. The bowsprit rigging could be mistaken for that of a real ship, and the general appearance is of weather-beaten but stanch and shipshape age

The rigging at the end of the bowsprit and the construction of the cap and martingale is made clear in the sketch below, which is practically full size



The topmasts are round up to the topmast trestletrees, and from that point square. The hole for their heels in the caps should really be large enough to let the mast pass through, but it is better to make a smaller hole and set the mast in it. The trestletrees and crosstrees should be firmly fixed. Holes are drilled in the ends of the latter; and holes for the brace blocks are drilled in the after ends of the main trestletrees. At about ⅛ in. below the trestletrees, drill fore-and-aft holes for the topsail halyard ties.

The mizzen topmast, topgallant mast, and pole are made in one piece, with a slight shoulder at each head.

The lowermasts are all white. The other masts are natural wood (brownish) except where they are double and at the topgallant mastheads and poles; these parts are white.

From the topmast crosstrees extend spreaders, which can be wire or 1½-in. needles.

The topgallant and royal masts are in one piece and have a shoulder and little crosstrees for the lookout man to stand on, and waist high above them rings are seized on each side to form the "spectacles" as indicated in the drawing at the right.

The lower and lower-topsail yards are hung on trusses. There are several ways of making these. The simplest is to use twisted wire, but it is better to use flat brass and push the prongs through the yard, the butt being pivoted to another piece which goes into the mast. The neatest easy way, however, is that shown in one of the detail drawings. Sheet brass is cut to go around the yard and squeezed and soldered together abaft, with a gap in the middle into which is pivoted a flat brass eye to go into the mast. Note that the lower truss is longer than that for the topsail yard, which should be as short as possible. The spike of this one goes through the cap, which must be most carefully drilled. The lower yards also have chain slings from the center of the yard to under the top.

The lower yards are fitted with eye-bands having two eyes at the yardarms; there is a small block above and a chain (brace pendant) abaft. A thin wire jackstay runs along the top, stapled down until it almost touches, and footropes with stirrups. These can be thin cord, but I found that wire keeps its place better. They are black, everything else white.

The lower topsail yards are similarly fitted, without the chain sling. The upper topsail yards are the same except for eye-bands having three eyes with the block underneath and with single blocks for the downhauls in the quarters. Instead of a truss, they have a saddle and an eyebolt for the halyards.

The topgallant yards have two-eye bands and thin wire pendants; otherwise they are the same. The royal yards have no pendants. Whalers did not carry their royal yards when on station, so these may be omitted.

The bowsprit is square, with a smaller square at the end on which the cap fits. The cap has a hole through which the jib boom slides. The latter is set back to the stem, just outside which it is lashed. On both sides of the bowsprit there are bees—cleats with vertical holes. Inside of these there are bolted 3/16-in. deadeyes, and underneath there is an eye for the dolphin striker. Underneath are two deadeyes (with one large hole) for the bobstays. The jib boom has three vertical holes for stays.

At the mizzen there is the spanker boom, "goosenecked" with two eyes to the mast, and with a two-eye band for the sheet and a three-eye band at the end for the sheet and span.

The gaff is similarly "goosenecked" and has a four-eye band for the spans and vangs.

The bowsprit is black, and the jib boom, spanker boom, and gaff are natural except at the ends.

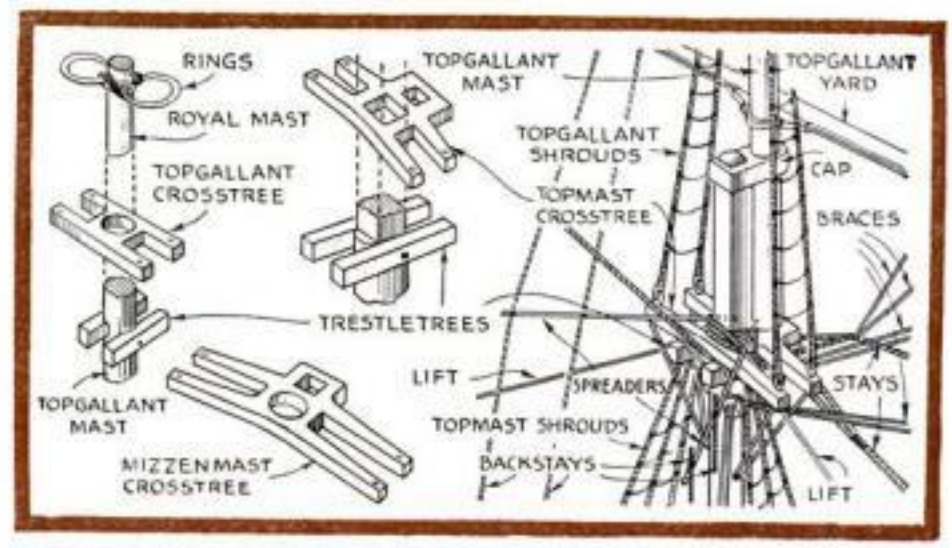
For the rigging at least four thicknesses of cord are needed. Fishing line is the best for all but the smallest size, which may be twisted silk. The largest or No. 1 size should be equal to about No. 18 gage (B. & S.) wire; the No. 2 size, to No. 20 wire; the No. 3 size, to No. 24 wire; and the No. 4 size, to No. 30 wire. For Nos. 1 and 2, use 3/16-in. deadeyes; for No. 3 use ⅛-in. For No. 2, use 3/16-in. blocks; for No. 3, ⅛-in.; for No. 4, 3/32-in.

Seventy-six 3/16-in. and sixty ⅛-in. deadeyes are required, as well as the following blocks: 3 treble, 8 double, and 6 single of the 3/16-in. size; 38 single and 14 double of the ⅛-in. size; 12 single and 6 double of the 3/32-in. size; also two 5/16-in. double blocks.

When the inner parts of the channels, with their notches, have been glued on, twist some No. 22 copper wire once under a deadeye, bring it down tightly over both channels, carry it around a small escutcheon pin in the hull at the position shown and up to the middle of the lower channel; then bring the other leg down to the same position and there snip the ends off. When the nail is driven home and the outer part of the channels is in place, these will hold all the strain you can put on them. For the last two deadeyes use the ⅛-in. size and No. 24 wire.

The shrouds are of black No. 1 cord. Seize a 3/16-in. deadeye in one end, reeve the cord through the lubber's hole, and carry it between the masts and down the other side for the first shroud only. Carry the other shrouds back on their own side. Into the other end of each seize another deadeye, so that all the deadeyes will lie evenly with about ¼ in. between them.

Close down to them seize a stiff piece of wire as a sheer pole to prevent them from twisting. Then at 3/16-in. intervals



A smaller sketch of the rigging at the point where the topmast and topgallant mast are joined, and details of the various crosstrees

put on the ratlines (steps). These should be size A silk thread clove-hitched to each shroud, except that only every fifth goes to the after shroud. At the mizzen there are only three shrouds.

The lower stays start at one of the bolts in the deck, are reeved through the top passed around behind the mast and back to the other bolt, and are seized together ¼ in. from the top. At the fore the stay comes under the bowsprit, and the two ends are tied together.

For the topmast shrouds, which are No. 2 cord, bore a hole through the lower mast ⅝ in. below the top. Twist a fine wire round a ⅛-in. deadeye, pass it through a hole in the top and through the mast, carry it up the other side and around another deadeye, so that they will rest tight on the top. Repeat this three times for the fore- and mainmasts. Put on the shrouds as for the lowermasts, taking them up between the crosstrees. At the mizzen there are only two, and instead of deadeyes make loops in the ends of the wires. The same applies to the fore and main topgallant shrouds.

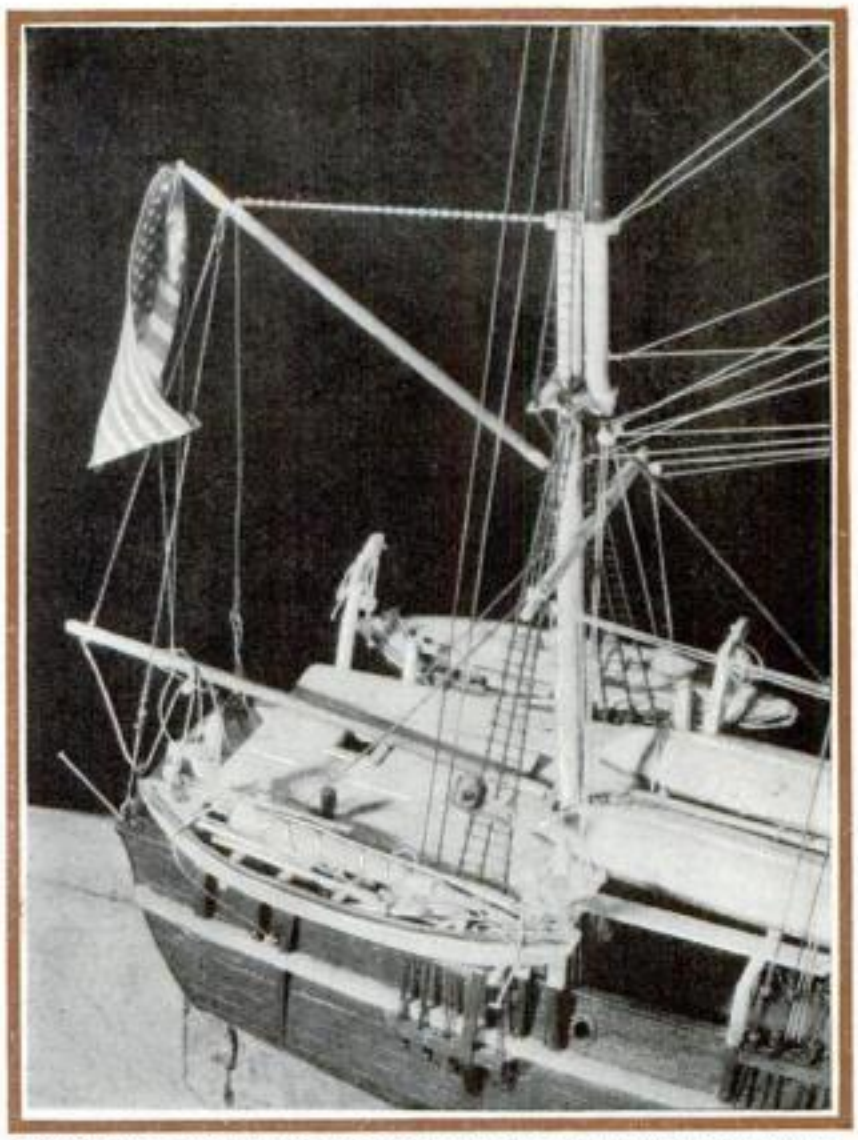
For the topmast backstays, use No. 2 cord, two each side (except at the mizzen). Pass the line up one side and down the same side. Shrouds and backstays always should be put on with the starboard pair first.

There are two stays of No. 2 cord from the fore and main topmast heads. These start with eyes and are finished as shown. The lower one (double) passes through the bees on the bowsprit and back to bolts in the bows; the upper (single) passes through the jib boom, under the cleat on the dolphin striker, and back to a bolt in the bow. The lower stay at the main goes through an eye in a band on the mast and fastens to a bolt in the deck; and the upper one goes to an eye in a band around the lowermast head at the top. The mizzen topmast stay is single, passes through an eye at the cap, and down to the top.

The topgallant and royal backstays are No. 3 cord. When tightened down, they are stretched out and seized to the outriggers to give them more spread. The stays are in the positions shown, those at the fore being reeved through holes as for the topmast stays.

Before we can add the head stays, the bowsprit must be fixed. This is square, with chamfered corners; it goes through the bow and has its heel cut to lie on the deck between the bitts. Below are two chain bobstays running from strap eyes on the stem and tightened up to deadeyes with lanyards under the sprit. From bolts in the position shown, other chains come to the sides and are tightened with deadeyes.

The martingale boom, or dolphin striker, hangs with an eye from an eye in the bowsprit, and has a wire cleat on either side one third the way up. From the inner and outer stops of the jib boom come light chains to a saddle that is either bolted or wire-seized to the end, and from the end come chain backropes to deadeyes on the cathead, next the ship's side. From the inner and outer stops also come boom guys of No. 2 cord, running to deadeyes on the cathead. Deadeyes of the ⅛-in. size look best on the cathead.



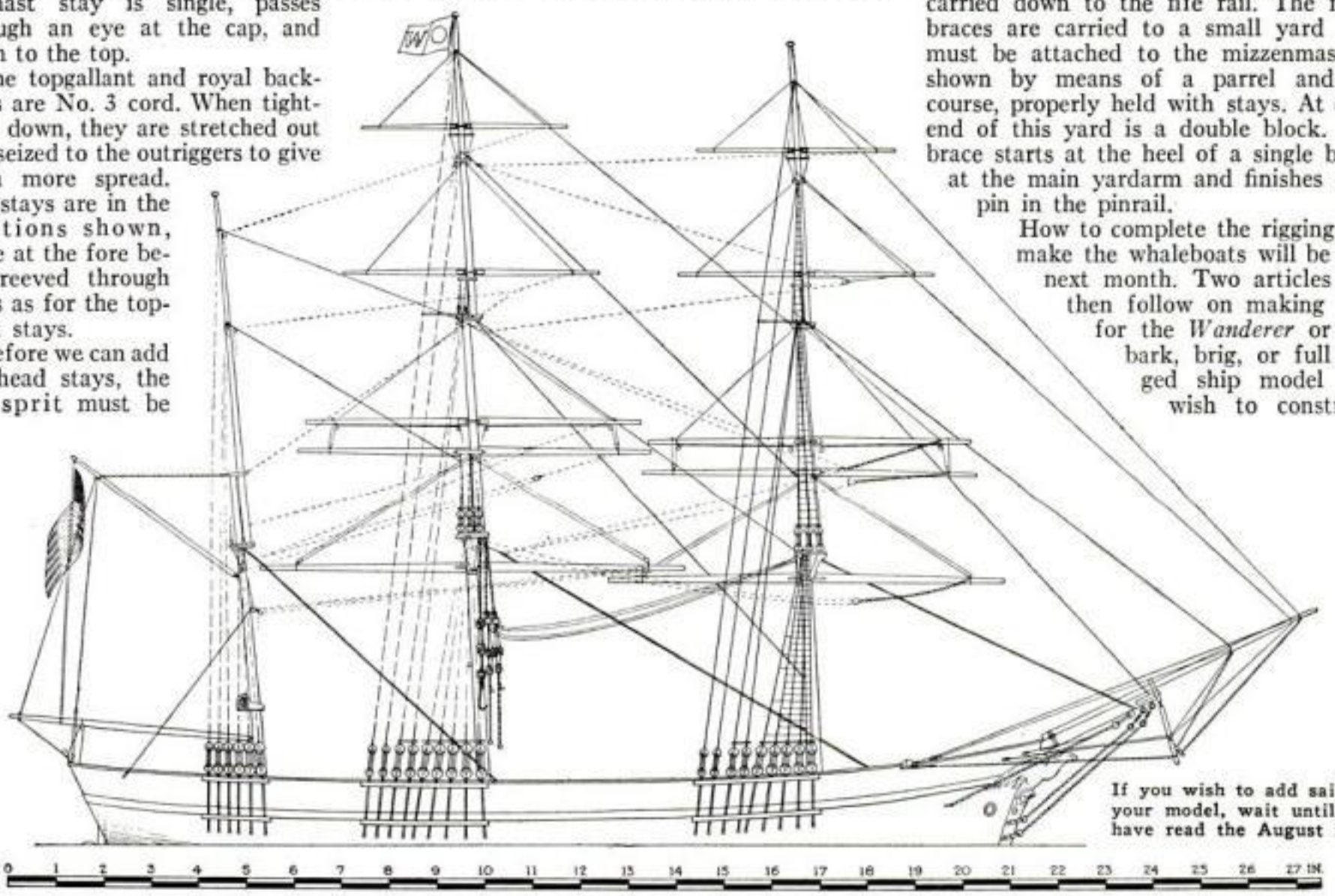
Unlike the other masts, the mizzenmast has only three shrouds. The spanker boom and gaff are fastened to it with goosenecks

All the rigging described to this point is black. In the Homecraft Guild kits a superior grade of black twisted linen fishing line is provided for this purpose. If white line is being used, it is best to color it by using aniline (household) dye.

The lower yards, which you have already fitted, should now be placed in position with the trusses and slings. The topping lifts of No. 4 cord start at the heel of the block at the cap. Reeve them through the yardarm block, through the cap block and down through the eyebolt in the deck, and belay to the pin band at the fore and to the fife rail at the main.

The fore braces, which are of No. 3 cord, start at a hole in the main cheeks, pass through the pendant block, through a block hung from the cheek, and are carried down to the fife rail. The main braces are carried to a small yard that must be attached to the mizzenmast as shown by means of a parrel and, of course, properly held with stays. At each end of this yard is a double block. The brace starts at the heel of a single block at the main yardarm and finishes at a pin in the pinrail.

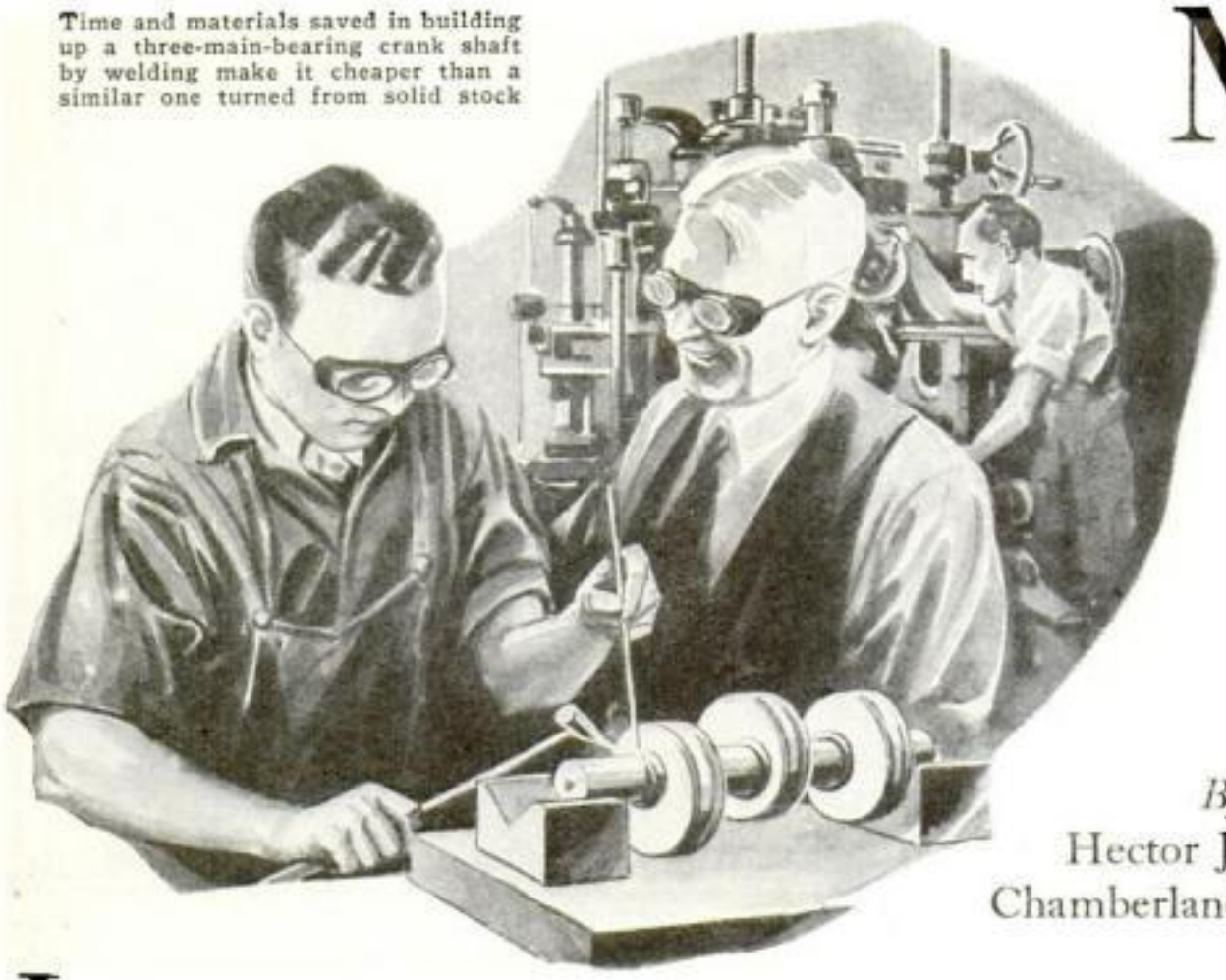
How to complete the rigging and make the whaleboats will be told next month. Two articles will then follow on making sails for the *Wanderer* or any bark, brig, or full rigged ship model you wish to construct.



If you wish to add sails to your model, wait until you have read the August issue

Where WELDING *helps the* Machinist

Tips on how to save time and materials in the everyday work of a small shop



Time and materials saved in building up a three-main-bearing crank shaft by welding make it cheaper than a similar one turned from solid stock

By Hector J. Chamberland

IN THOSE emergencies which are continually arising in every machine shop—difficult repair jobs, work with rush tickets attached, and parts which have to be made in small lots with limited equipment—welding will often save the day. Welding can be relied upon to duplicate perhaps as many as seven out of every ten requirements that otherwise would call for a forging or a casting.

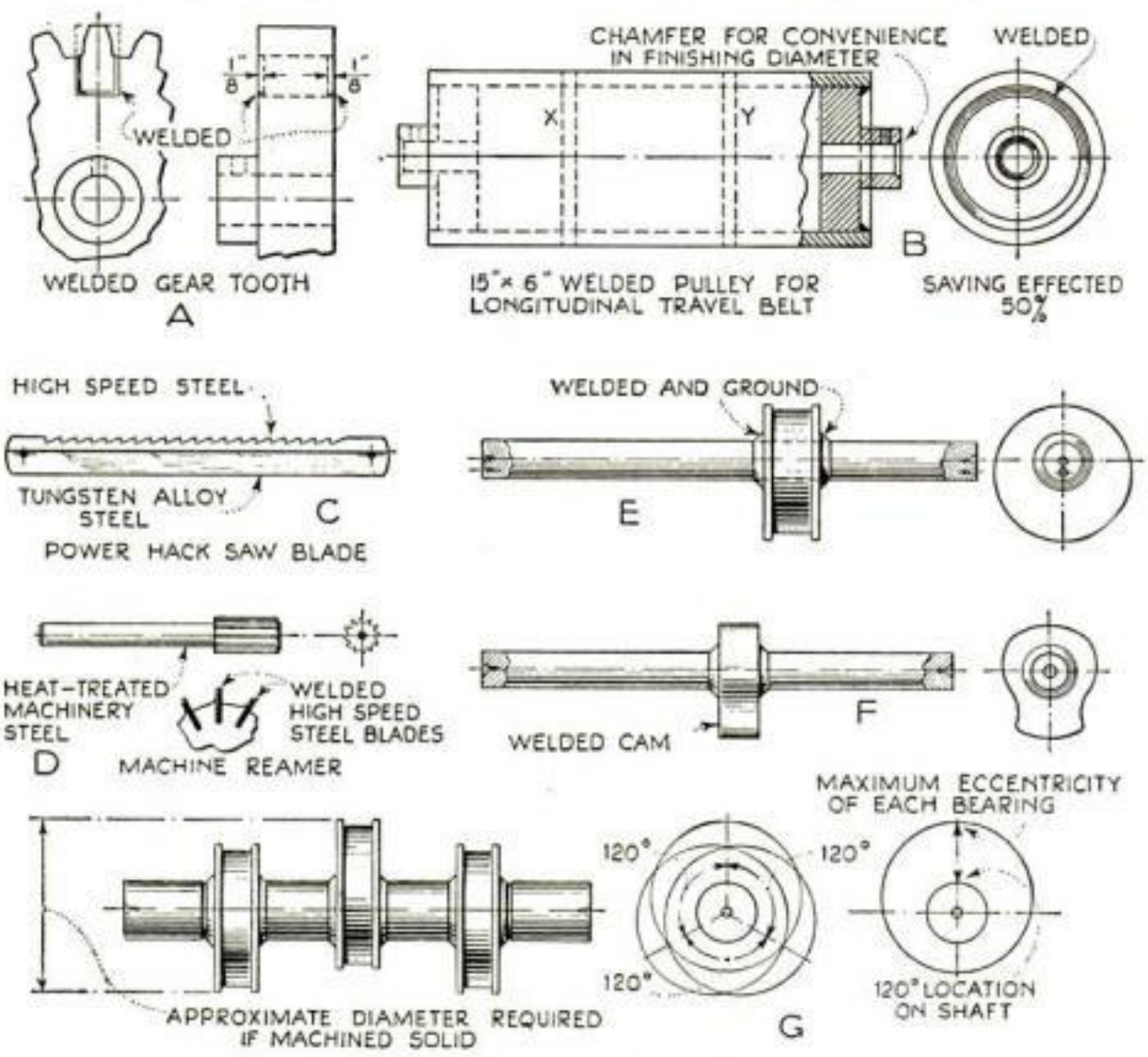
To take one of the most elementary examples, a broken tooth in a large gear can quickly be replaced as shown at *A* in the accompanying drawings. All that is necessary is to mill out a section and fit in a piece of machine steel tight enough so that a new tooth can be formed on the shaper and finished with a file. A welded section ⅛ in. deep on each side will make this a permanent job.

A pulley or roll of any kind—for instance, one like that shown at *B*—can be made for half the price of a pattern and casting, providing, of course, that pipe or tubing stock is available in the size required. To obtain good results, the following suggestions should be observed: The cylinder is trued in a lathe chuck after fitting a hardwood bushing in that end so as to allow a good hold for the jaws. The other end is then bored out just enough to get a concentric hole. Next a light chip is taken at *X* and *Y* in order to obtain two concentric surfaces on the diameter. After another wood bushing is fitted in the end already bored, the piece is reversed and trued up with the indicator at *X* and *Y*. It will be found that, after the second boring, both bearings are perfectly in line with each other whether they are of the same diameter or not.

Machine steel bushings are then fitted as shown; these should be a medium pressed fit. The assembly is now ready for welding, and this should take very little time. By properly centering a piece of cold-rolled steel to be used as a test shaft, it is necessary to turn from the diameter only a sufficient amount to make the job perfectly concentric.

One has only to compare the cost of welded tools such as those shown at *C* and *D* with similar tools made from solid high-speed steel to be convinced of the benefits derived from welding, either by saving time or material. In one case under the writer's observation, the use of hack saw blades of the type shown at *C* effected a saving of 60 percent in six months, and the use of reamers like *D*, 50 percent.

Good examples of timesaving welding jobs, whether resorted to for emergency or permanent use, are given at *E* and *F*. Any man familiar with machine shop practice knows what it costs to order such parts from the manufacturers of the machines, besides the inconvenience of waiting sometimes for several weeks. It makes no difference whether a single-throw crank shaft or a single cam shaft has to be duplicated or whether the originals were of the forged or solidly turned type. If either



How welding can be used to repair a gear *(A)* and build up pulleys *(B)*, special tools *(C* and *D)*, single crank and cam shafts *(E* and *F)*, and large three-main-bearing crank shafts *(G)*

is made in two parts by allowing a .002-in. drive fit of the bore on the shaft and then welded as shown, they will never cause trouble; provided, of course, they are within reasonable sizes. It is understood, naturally, that any original machine part of this type ordinarily would be made from solid round stock or forged; however, with a large cam shaft welding is practical in any case.

To demonstrate further what welding can do to save time and material, study the three-main-bearing crank shaft shown at *G*. While this was made for experimental purposes, the drawing clearly shows the amount of waste that would have resulted had the job been turned from a solid piece of stock. These crank shafts are now made from forged billets for regular production.

TO MAKE an experimental or replacement unit such as this to any required dimensions, the first thing is to center the shaft and turn it to size plus .015 in. It is then ground all over, taking the end bearings first and then stepping the middle section to three different sizes so as to allow a .002 in. drive fit for each connecting-rod bearing. The shaft is then located on centers in the milling machine. With a pointed tool clamped between the collars of the arbor and set on center, a light line is scratched along the section of No. 1 bearing. After indexing 120 deg. this is repeated on bearing No. 2, and finally on bearing No. 3.

In making the eccentric pieces, stock of sufficient length and diameter is centered and turned to size. Three pieces are then cut off, allowing ⅛ in. for facing them parallel. This last operation completed, a radial line is scratched on one side of each piece, the centers are located, and the eccentric locations prickpunched accordingly. The pieces are then ready to be strapped on the faceplate of a lathe for boring. The bores vary by .002 in. and there is also the .002-in. driving allowance to be considered, so the adjustable reamer is set accordingly. After being bored, the pieces have only to be lined up on the shaft by matching the lines accurately and then driven to their proper locations. The job, still in a rough form so far as the connecting-rod bearings are concerned, is ready for welding, which consists of forming fillets on each bearing.

If care was exercised in laying out and boring, the crank shaft is as accurate as can be expected, and it is necessary only to finish the eccentrics to their required diameter. This is done, of course, with the usual equipment—throw-blocks—and the ordinary procedure is then followed.

The wide-awake mechanic, as a general rule, will find welding is profitable to all concerned. As applied to the reduction of tool cost, welding should interest every man engaged in machine shop work, because the welding operation itself is secondary to the knowledge of preparing and assembling the parts.

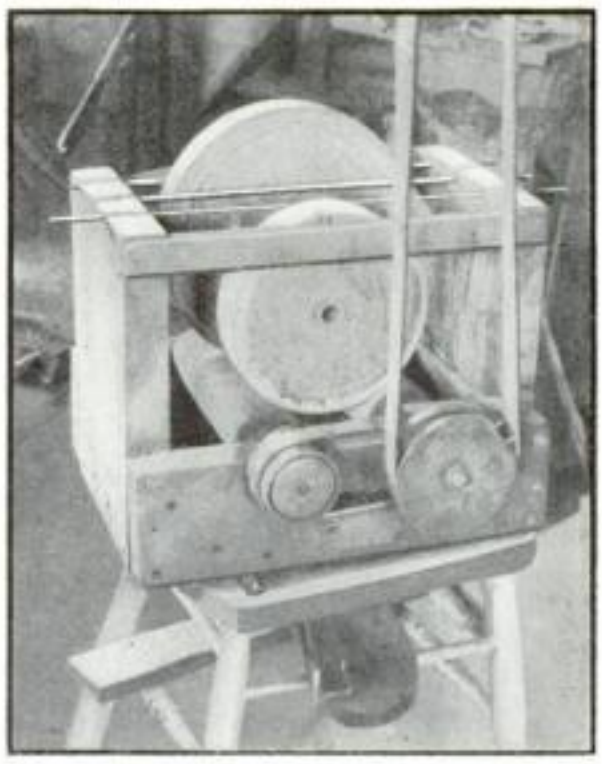
In this article and a previous one on welded jigs and fixtures (P.S.M., May '32, p. 88), Mr. Chamberland has pointed the way to various worth while economies in small machine shops. Some of our readers, however, may not agree with him as to the strength of the welds in certain of the examples he has cited, particularly those on the gear tooth and on the built-up crank shaft. Comments and suggestions from shop men who have had practical experience with similar welded constructions will be welcomed.—The Editor.

HORIZONTAL RIG FOR PORTABLE DRILL

The portable drill, held in a light frame, is controlled by means of a 30-in. handle

WHEN drilling and tapping holes horizontally inside the circle of a large collar or cylinder, this light drill frame makes the work easier as well as faster. The main supporting members are made of 2-in. angles, cut and welded near one end in such a way that they flare out sideways when assembled. This end is braced by bolting on a section of thin plate; the other end is braced with a light bar. The bottom flange of each angle is cut away at the ends so as to drop inside the ring or cylinder being drilled.

A slot 8 in. long is cut in each lower flange, and the portable drill is suspended in a clamp of ¼ by 2 in. steel, the lower member of which extends through these slots. The drill is moved forward or backward with a 30-in. lever of light bar stock. It is loosely bolted at the end to one of the angles and attached to the grip of the drill by means of a toggle clamp of light steel, which allows enough play up and down so that the drill will not be cramped. The drill frame, being of light construction, can be easily moved from one job to another.



MOIST ROLLERS REMOVE ABRASIVE FROM USED POLISHING WHEELS

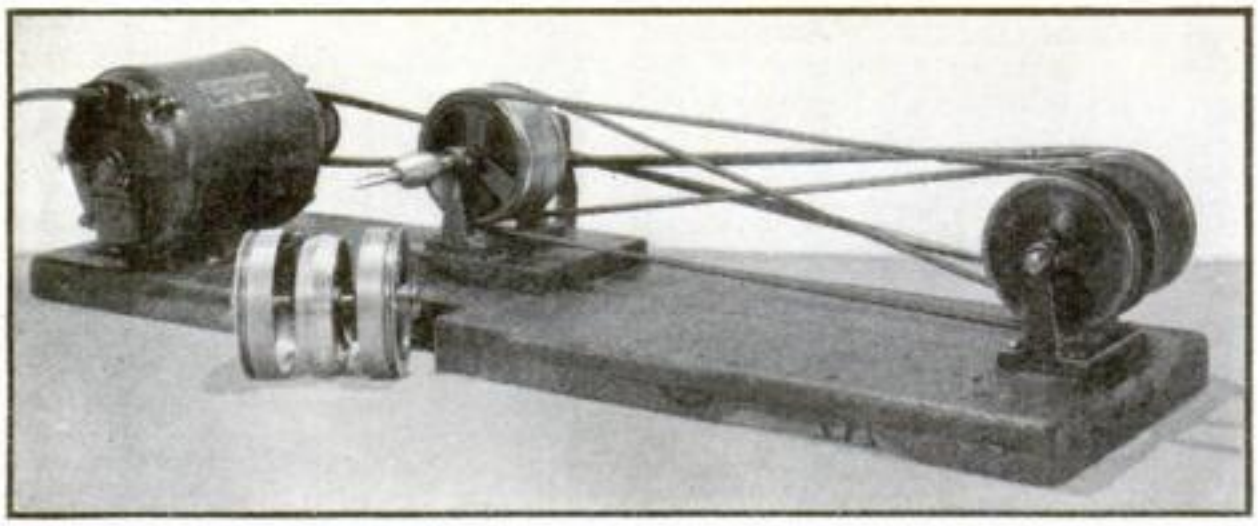
THE abrasive strips used on polishing wheels are easily removed with the device illustrated. Mounted in the lower part of the framework are two wooden rollers, each of which has a small pulley on the end of its metal spindle. A short belt passes over the two pulleys. A larger pulley on one of the spindles is belted to a line shaft so that the rollers will revolve in unison. The bottom of the box, which forms a trough, is filled with water until the rollers are barely moistened. The polishing wheels are then placed on the rollers and separated by small metal rods laid in grooves in the ends of the framework. Then they are allowed to turn on the wetted rollers until the moisture loosens the glue beneath the abrasive.—S. E. P.

GRINDING wheel spindles that are run continually should be washed out frequently with kerosene or gasoline.

A QUICK WAY TO CLEAN CONVEYORS

WHILE a gravity conveyor like that illustrated was being used to convey dirt incrusted blocks, it became necessary from time to time to clean the rolls. This was done quickly and easily by the following method. The chuck of a small electric drill was wrapped with friction tape until it had been built up about ½ in. thick. One man held the padded chuck of the drill against the face of each roll to serve as a friction wheel for driving it, while the second man pressed a scraper against the roll. At the end of the job the rolls were sandpapered by the same method. After a thorough cleaning, a thin protective coat of oil can be applied to the rolls, if desired.—WILLIAM K. WEBB.

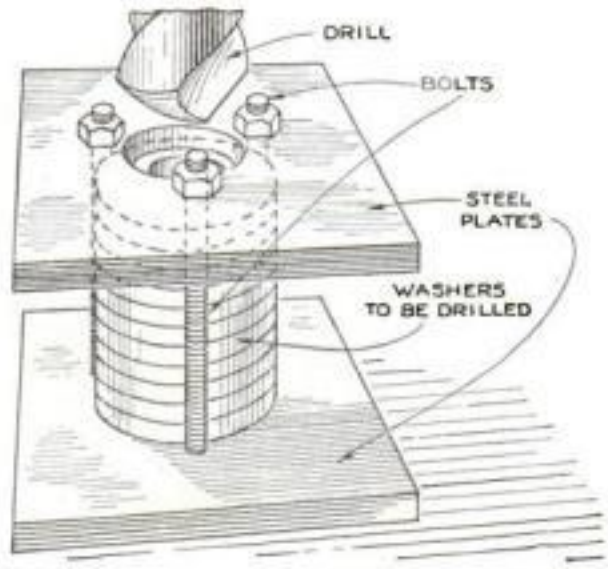
Each roll is first scraped and then sandpapered



SPEEDY SHOPMADE TAPPING MACHINE

BECAUSE of the expense of buying a tapping machine or a tapping head for the drill press, the writer designed and made the one illustrated above. It has proved highly efficient and to date has threaded more than two million holes in a variety of work passing through a large western manufacturing plant. Holes have been threaded ranging in size from 2-56 to ¼-20. A similar machine can be built without difficulty from spare parts to be found around almost any ordinary shop or factory. A ¼-H.P. motor drives the tapping head by means of a countershaft using V-pulleys and round belts. One belt that runs to the friction clutch is crossed; the other one is straight. The photograph shows the machine set up for use, as well as an extra friction clutch which has been dissected to make the construction clearer. The center cone of the clutch is approximately 1 in. wide and 4 in. in diameter, and it has a 15-deg. bevel machined both ways on the face—that is, a double bevel. This central member is hollowed out to reduce its weight, and it is fastened with a set screw to the shaft. The two outside cones are alike and, of course, are bored to match the 15-deg. bevels of the central cone. They are a running fit on the shaft and are kept apart to allow the tap spindle a lateral movement of approximately ⅛ in. The chuck shown was taken from a discarded breast drill and threaded as necessary to suit the tap spindle.—LEONARD E. FABER.

SIMPLE FIXTURE IS AID IN DRILLING WASHERS



How to clamp washers together when a number have to be drilled with holes of larger size

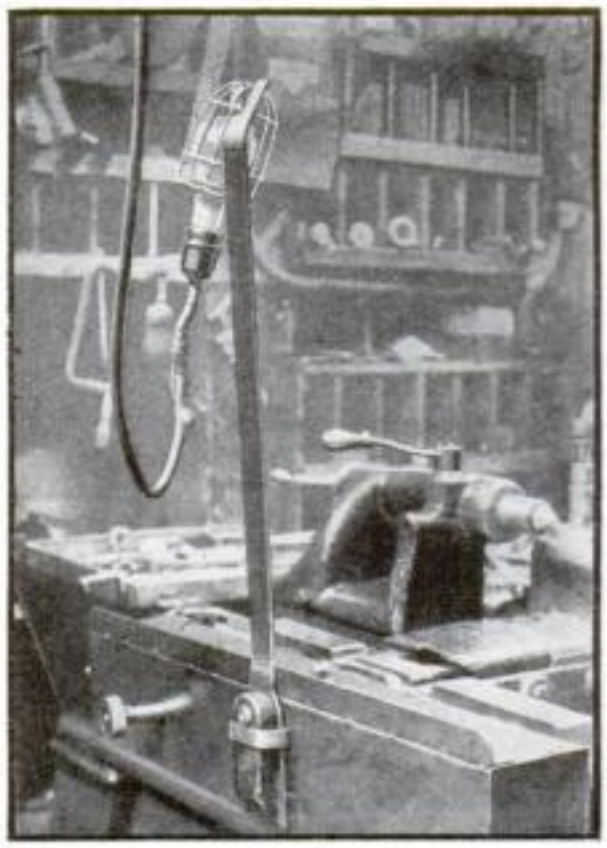
DRILLING washers with larger holes is a slow and tiresome job if they are drilled individually, and it usually results in a rough or burred job. Where there are many washers to be drilled, a simple fixture that helps to do the work quickly can be made as shown. In operation, the washers are stacked to the capacity of the fixture. A rod (of the same diameter as the holes in the washers) is pushed through the pile, and the nuts are then tightened. The rod is removed, whereupon the washers are in position for drilling as illustrated.—JOHN SERAFIN.

DRILL CHUCK KEY HELD ON SWIVELING CHAIN

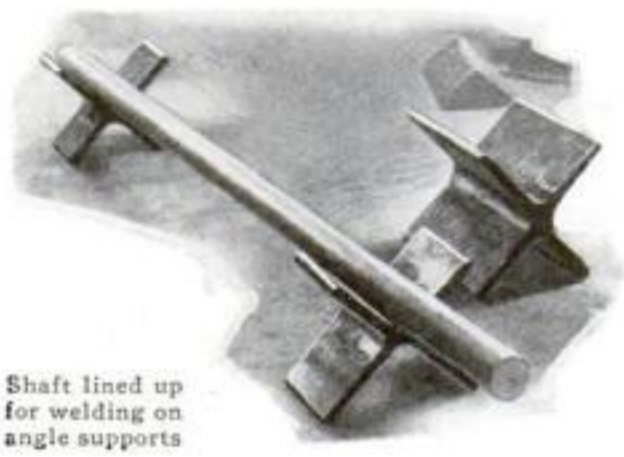
EVERYONE who uses an electric drill knows the importance of having the chuck key handy and ready for instant use. One of the most convenient ways to attach the key to the drill is to use an ordinary pull chain from an old electric light socket or a similar chain found on drain plugs. Solder a wire loop to the end to be fastened to the key, and solder an electric wire terminal or soldering lug to the other end. Remove one of the screws holding the handle on the drill, slip it through the hole in the copper terminal lug, and replace the screw. Because of the peculiar ball and socket design of the pull chain, it is really a series of small swivels, therefore it will not become tangled or kinked no matter how it is twisted.—GLENN W. HARDING.

LATHE DROPLIGHT MOVES ALONG WITH CARRIAGE

THE lathe droplight illustrated moves along with the carriage and therefore insures adequate illumination at all times without any attention on the part of the machinist. It is supported by a bar ⅛ by 1½ by 30 in. with a small fork at the upper end and a larger fork at the lower. The larger fork straddles the outboard bearing of the cross-feed screw and is held in place by means of a metal clamp. The droplight is hung on the upper fork. In addition to its novel lighting arrangement, this 16-in. lathe also has a cover for the back to keep out dirt and incidentally to serve as a bench for whatever small tools are being used. The cover is made of No. 17 gage sheet steel notched at the lower edge to fit over the outboard bearing and over the adjustment screw, and it has a section of 1½ by 1½ in. angle welded to the outer top corner as shown to act as a stiffener.



ANGULAR SUPPORTS FOR WORK TO BE WELDED

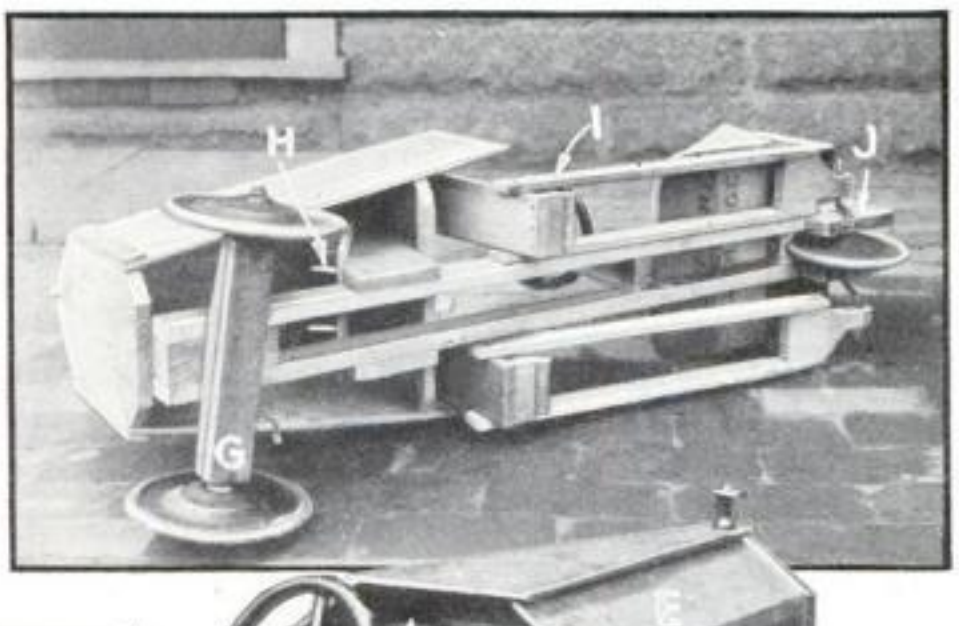


Shaft lined up for welding on angle supports

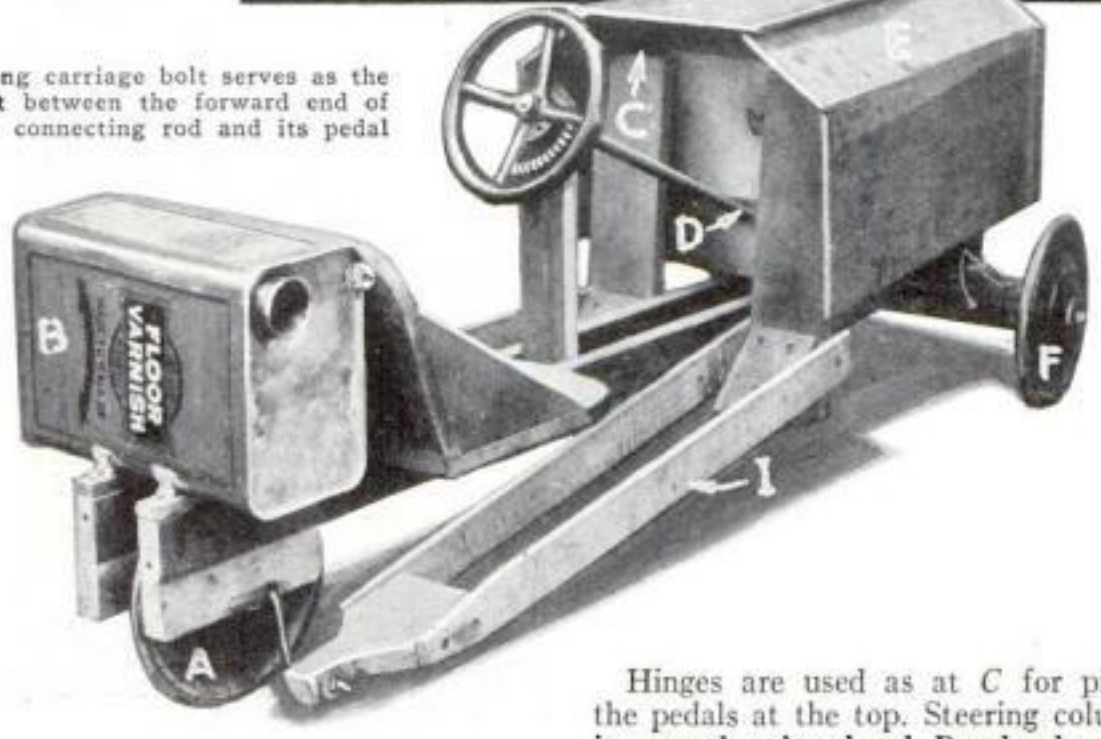
AT THE welder's bench a number of V-supports made by welding together short sections of angle stock will be found useful in lining up shafts and numerous kinds of small work. Each of the supports is made by welding two of the sections at the corners as shown, thus forming four V's. By using angles of different sizes in one assembly—4 and 6 in. for example—the height of the V's will vary when the unit is turned over. Thus not only straight shafts but also those with crooks and short offsets may be lined up properly in these supports.—JOSEPH C. COYLE.

PEDAL CARS BUILT FROM SCRAP PARTS

Some scrap lumber, a square can, and the wheels from a discarded kiddie-car tricycle are all the materials needed to build a pedal car



View of underside of the sidewalk car. The driving wheel is at the rear. The construction shown at *G* can be altered if the axle is drilled to receive bolts. Sash pulleys placed at *H* reverse the direction of the steering rope



A long carriage bolt serves as the pivot between the forward end of each connecting rod and its pedal

HERE is a new type of sidewalk vehicle, built almost entirely from scrap parts, which will delight the youngster and amuse the adult. The action of the connecting rods suggests a locomotive.

Although the construction is obvious, a few notes in regard to the materials may help. For the drive wheel *A*, use the front wheel of a kiddie-car type of tricycle. Drill two holes in the crank arms for the cotter pins that hold each connecting rod in place. The gasoline tank *B* is a 1-gal. varnish can with the handle removed and a few sheet metal lugs soldered on for attaching it to the rear of the car. A small hole punched in the bottom allows the water to trickle out and provides for make-believe fuel consumption.

Hinges are used as at *C* for pivoting the pedals at the top. Steering column *D* is a wooden dowel rod. Box lumber serves for the hood *E*.

The wheels *F* are the rear wheels from an old tricycle. The front axle is cased in with wooden strips as at *G* if it happens that there were no holes drilled in it so that bolts can be used. Sash pulleys *H* serve for changing the direction of the steering rope; they are mounted on a board as shown. The principal members of each connecting rod *I* are two long slats. In assembling the connecting rods and pedals, use screws instead of nails. Connect the ends of the two connecting rods to the pedals with carriage bolts. The drive wheel axle *J* must run in metal bearings of some kind; in this case they were made very simply from strips of 18-gage sheet metal.—R. W. WAGNER.

CHINA MENDED WITH AID OF GUMMED TAPE

IN REPAIRING broken china, crockery, or glassware, ordinary adhesive tape will often aid in clamping the parts together until the cement is hard. In the case illustrated, the teapot spout was broken about halfway down. Household cement suitable for use on china was applied to the parts. The adhesive tape was then quickly stuck at the top just inside the opening, carried over the end of the spout with reasonable tension, and pulled down tightly and stuck on the bottom of the pot. The adhesive tape will stick better if it is warmed slightly over a radiator or light bulb before it is applied.—HAROLD P. STRAND.

COMBINED BOX AND SEAT FOR TICKET TAKERS

TICKET takers, especially at school games, bazaars, and amateur entertainments, often have moments when they would welcome an opportunity to sit down and rest. This is particularly true where the main box office and field entrance happen to be some distance away and the ticket taker on duty is not kept continually busy.

The accompanying photograph shows a combination seat and ticket box used at the entrance of a western high school athletic field. It is made of ¾ in. pine and is 13 in. square at the bottom, tapering to 9½ in. at the top. The bottom board is kept up 1 in. from the lower end. The seat is 1 in. thick and 11 in. square with a slot in the center for the tickets. It is fitted with two hinges and has a small hasp for a padlock.—FRANK W. BENTLEY, JR.

When not busy, the ticket taker can use the top of this unique ticket box as a seat

CAMERA *Shutters*

. . . AND WHAT YOU SHOULD KNOW ABOUT OPERATING THEM

By *Frederick* D. R*yder, Jr.*

Fig. 1. One of the latest types of pocket cameras. It has been set with the iris diaphragm adjustment at 11 and the speed adjustment at a twenty-fifth of a second

Fig. 2. Exposures of brief duration can be made without jarring a light camera by setting the shutter on "time" and controlling the actual exposure by means of a piece of black cardboard

"I WISH I could sell a chunk of photographic knowledge with every camera," a photo dealer sighed as I drifted up to the counter. "Did you notice that man going out as you came in? He's just bought an elaborate camera with all the fixings, supplementary lenses, and so on, and I'll give you almost any odds he'll be back inside a week blaming the camera for all the poor pictures he takes."

"What makes you think he's so dumb?" I asked.

"Well, in the first place," the dealer explained, "he thinks that all you have to do to get fine pictures is to buy an expensive camera. I started to tell him how the shutter controls worked and he wouldn't even listen. 'Just set it for average work—that's all I want to do,' he directed, like a fellow asking a mechanic to set the carburetor on his car!"

After all, a camera is only a tool with which to take pictures, and you can't expect good results with any tool until you know how to use it. As I explained last month, the camera lens is the most important part of the outfit, but the shutter certainly comes next. The lens forms the picture out of cones of light, and the shutter controls the length of time the light is to act on the sensitive film and the size or intensity of the cones of light.

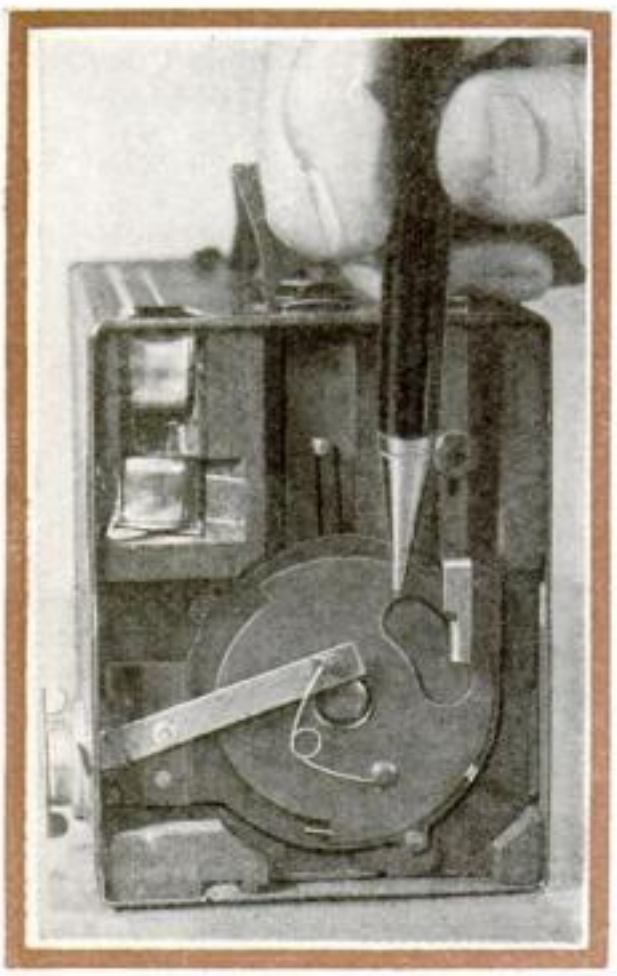


Fig. 3. The slotted disk used as a shutter on box cameras. Behind it is a sliding strip with holes or stops of three different sizes

THE THREE S's OF PHOTOGRAPHY

SET SPEED
SET FOCUS
SET OPENING

All photographic shutters, from the simplest to the most elaborate, are theoretically alike. Each has a mechanism for opening and closing the hole through the lens with great rapidity. In addition, there is another and quite separate mechanism for regulating the size of the hole through the lens. The first or opening and closing mechanism may, of course, be made in several different ways. Its function is to regulate the length of the exposure. The other mechanism, called the stop or iris diaphragm, governs the size of the opening through the lens by which light may pass while the opening and closing device is in the open position.

The simplest camera shutter, one that has given fine service on millions of cheap box cameras, is shown in Fig. 3. My pencil is pointing to the shutter itself, which consists of a thin metal disk with a slot in it. When the lever at the side of the camera is pushed to the opposite position, the ingenious spring arrangement first resists the movement; then, as the lever passes a certain point, the disk suddenly revolves and the slotted hole passes the lens opening, allowing light to flow through the lens for approximately one twenty-fifth of a second.

Back of the revolving disk is a strip of metal with three different sized holes in it. Any one of these holes or stops can be placed before the lens by pulling out the metal strip. There also is another piece of flat metal that can be adjusted to engage with a projection on the rim of the shutter disk and hold it with the slot over the lens when it is desired to take time exposures.

With a simple shutter of this type you have, therefore, a choice of three different stops and one snapshot shutter speed. When the largest stop is before the lens and the object you wish to photograph is in the bright sunlight between the hours of ten in the morning and three in the afternoon, you can take snapshots. If you use *(Continued on page 101)*

Gangway for a couple of Kids you know!

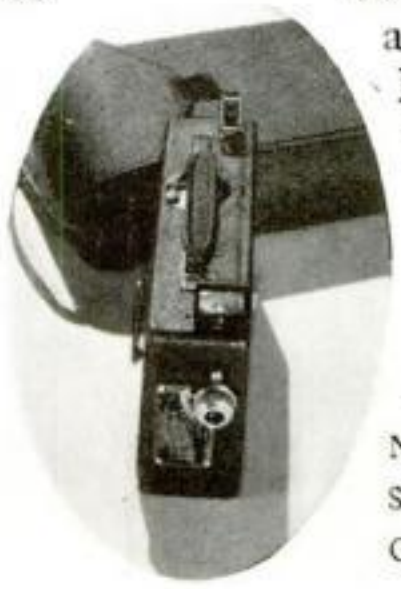
Into action instantly. Simply aim, press the lever... and you're actually making a movie

Keep a Movie record of the years that can never be lived again—

BEFORE you know it, that old wagon will be up in the attic . . . and they'll be away from home . . .

But your Ciné-Kodak captures forever the glorious moments of those few short years of growing up.

Ciné-Kodak M, price $75, makes clear, sharp movies the first time you try. It's as easy as taking the simplest snapshot. No focusing. Aim the camera, press a lever. That's all there is to it. Kodascope projectors now reduced as low as $50. Many dealers offer easy terms. Eastman Kodak Company, Rochester, New York.



CINÉ-KODAK ***Model M—Only $75 with case***

Into this compact little camera, Eastman has concentrated all the essentials of movie making. Equipped with f.3.5 lens and a special attachment for close-ups. No focusing. Loads with full 100 feet of 16 mm. film.

EASTMAN KODAK COMPANY • ROCHESTER • NEW YORK
Send me FREE illustrated booklet telling me all about making my own movies. P.S. 6-32

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CINÉ-KODAK *Simplest of Home Movie Cameras*

HERMAN HJORTH, *woodworking expert,*

designs a beautiful new

Cigarette Box

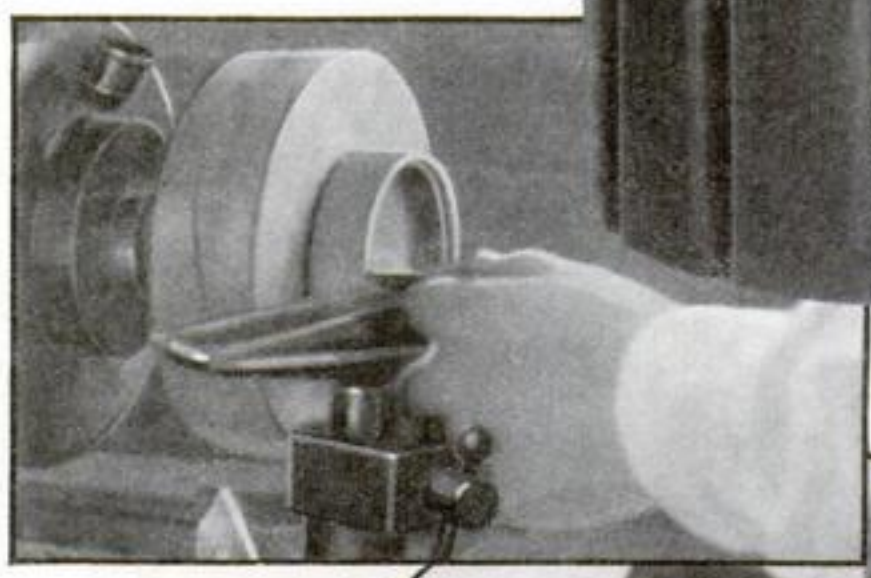
FOR WOOD TURNERS TO MAKE

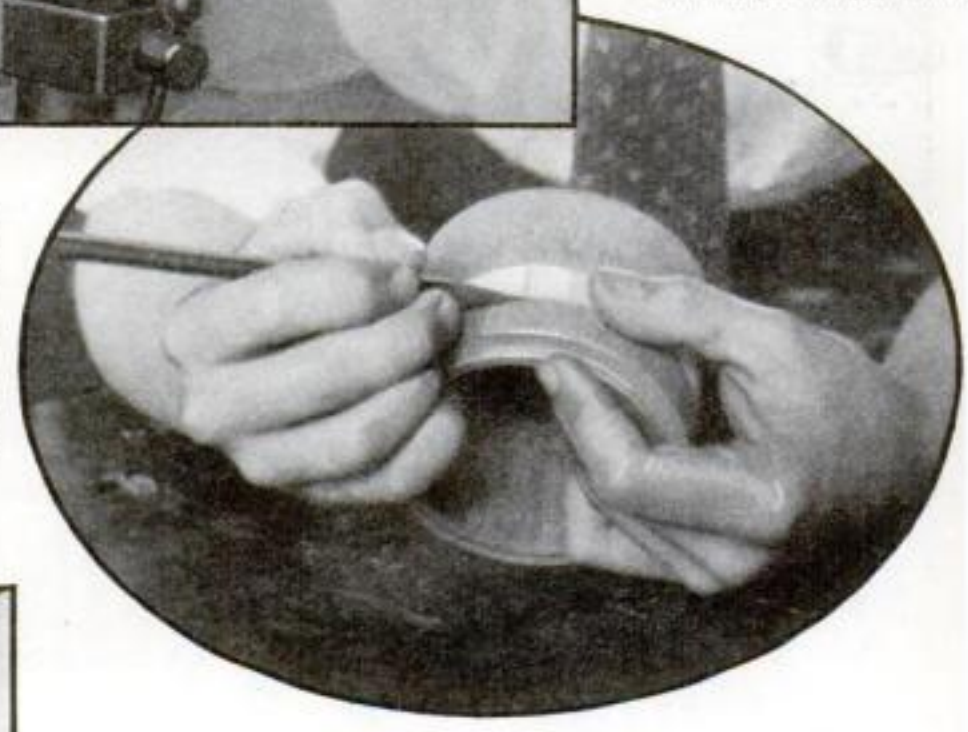
The beauty of this modern cigarette container lies in its fine proportions and simple straight lines

EVERY amateur wood turner will enjoy making this distinctive, modern looking cigarette box, either for his own use or as a gift. It would be difficult to find a neater and more satisfactory container for forty cigarettes. Its beauty, which lies mainly in its simple lines and fine proportions, can be enhanced by using mahogany, walnut, satinwood, ebony, or other wood of excellent color and grain.

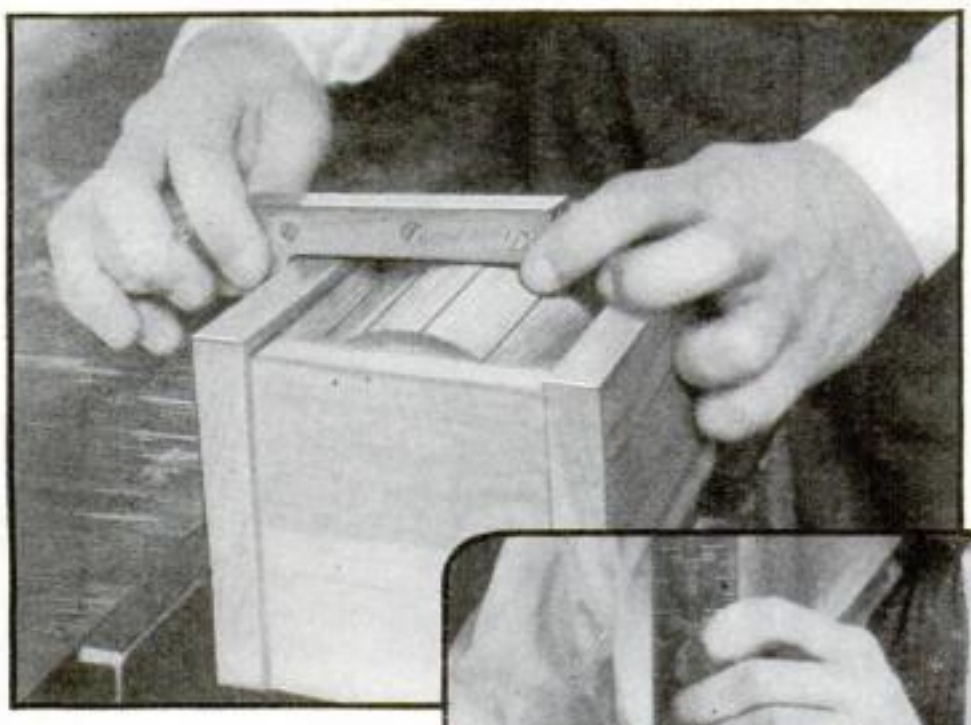
The lower part may be turned from one piece or made from two pieces glued together. In the latter case a piece of stock 2 in. thick, 4 in. wide and 6½ in. long is necessary. Plane the face of this very carefully, saw it in two, and glue the planed surfaces together. It is very important that they fit accurately and that a first-class gluing job is done, otherwise they are likely to fly apart when put in the lathe.

When the glue is dry, square one end and round off the corners. Screw a 3-in. faceplate to the squared end and put the work in the lathe. Using the dead center to support the piece, turn it to the required diameter *(Continued on page 111)*



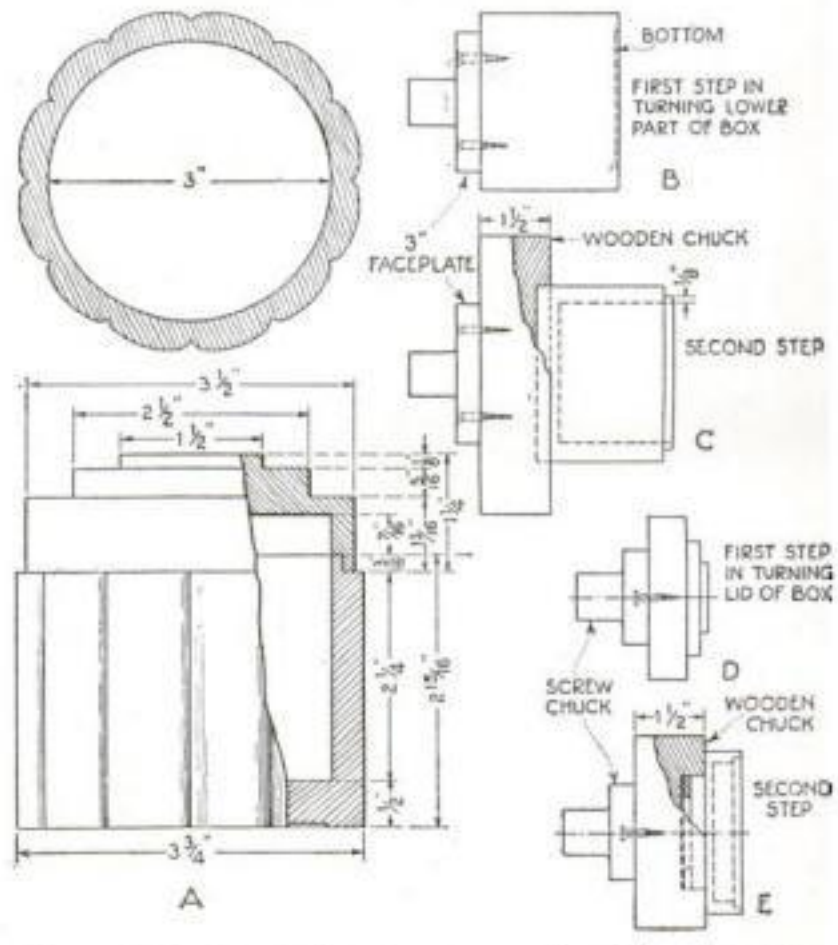


In turning the inside of the lid, a wooden chuck is used to hold the stock as shown above. A paper strip, wrapped around the box as at the right, aids in dividing the sides into 12 equal parts for the reeds



How the scratch stock shown in drawing *F* can be used to shape the reeds. Two wedges prevent the stock from turning while each reed is cut

When the 12 reeds have been carefully located by means of a paper strip as indicated in another photograph, the vertical division lines are drawn in with the aid of a square. An alternative design is given in drawing *G*



Measured drawing of the cigarette container *(A)* and details *B, C, D,* and *E* illustrating the steps in the construction

SEATLIKE SWING MOVES IN ANY DIRECTION

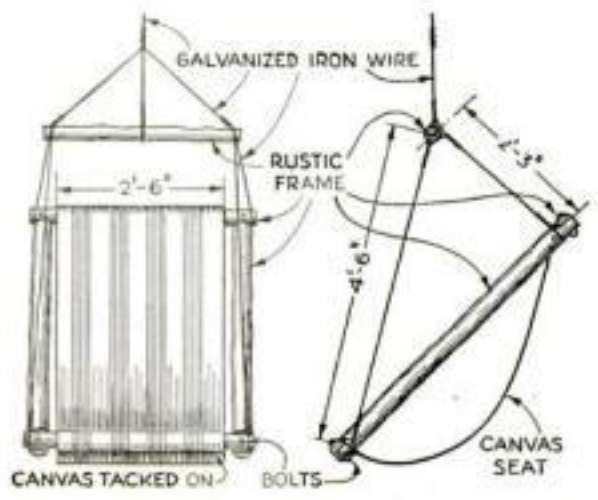
A COMFORTABLE swing for either children or "grown-ups" can be made as illustrated. This is often called a "Norwegian swing."

Obtain five pieces of reasonably straight tree limbs, preferably birch, and trim off all small branches, leaving the bark intact. A swing of ample size may be constructed by using 2 sidepieces 54 in. long

by from 2½ to 3 in. in diameter, 2 end pieces 36 in. long by from 2 to 2½ in. in diameter, and 1 hanger 32 in. long by 2 in. in diameter. Notch the hanger at ends and in the middle to keep the wires in place. Cut away one half of the stock at the ends of the four pieces for the frame to make half-lap joints and fasten together with 5/16-in. bolts, countersinking the heads and nuts.

The canvas should be tacked to the bottom piece before the latter is bolted on and then arranged so that it encircles both crosspieces at least one turn; then all the strain will not be on the tacks.

For suspending the swing ⅛-in. galvanized iron wire will do, although chain would look better.—A. C. JOHNSON.



Half-lap joints are used at the corners of the seat frame. These are held with bolts

IMITATING WORMHOLES IN "ANTIQUE" WORK

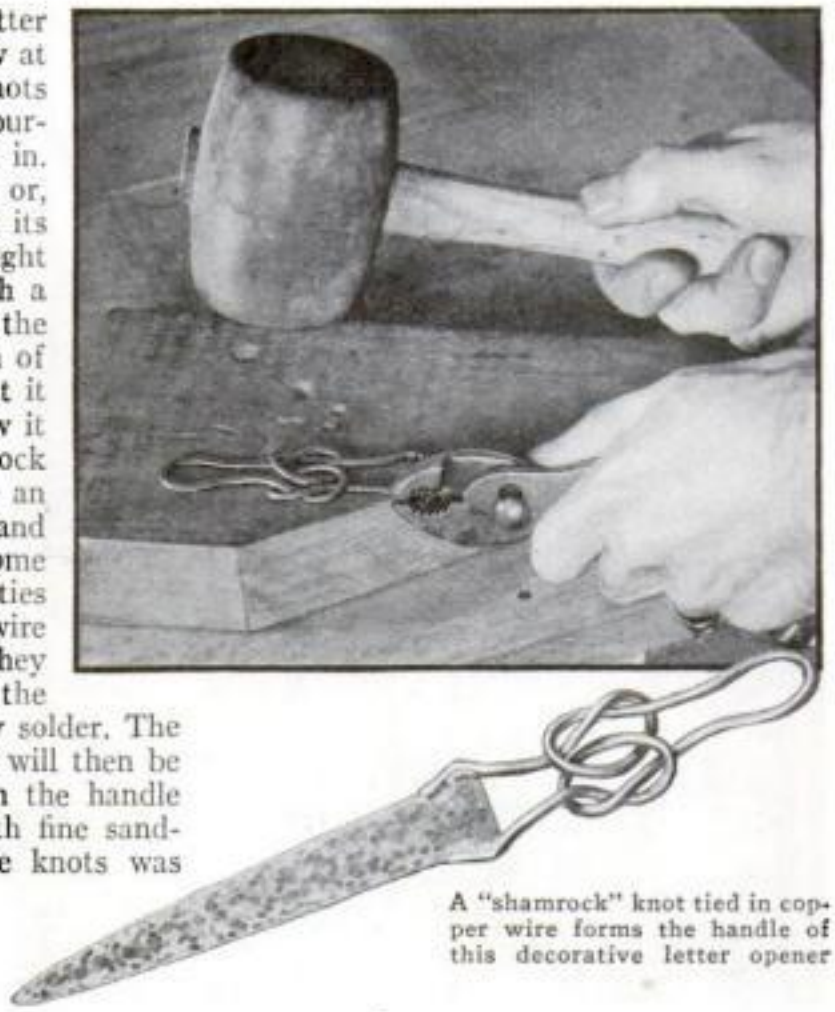
IN MAKING the imitation antique furniture that is so popular today, wormholes or the surface scars that resemble the little tunnels made by borers are often considered desirable. A simple and quick way of producing such marks is to lay a bent nail on the surface to be antiqued, and strike it a sharp blow with the ball end of a machinist's hammer. Another way is to burn the holes with red-hot nails or wire. Such depressions already have the desired blackened appearance, but those produced by the hammer method must be treated with stain to make them appear dark.—R. T. O.

DRIVING NAILS SO THE HEADS DO NOT SHOW

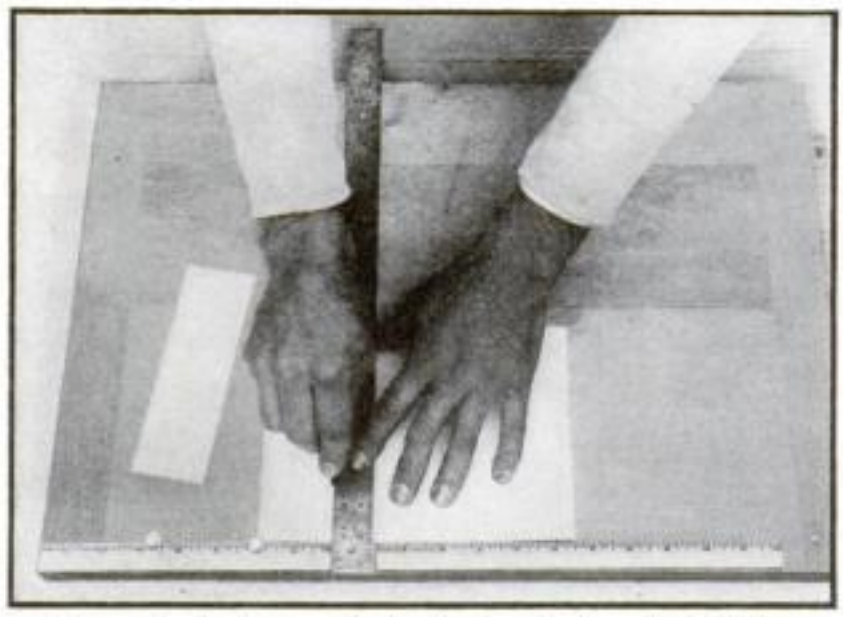
CHIP nailing, a trick known to many old-time cabinetmakers but apparently overlooked by most present-day workers, enables you to nail two pieces of wood together securely, yet conceal the nail-heads. With a very sharp chisel raise a small chip at the point where the nail-head is to be hidden. Bend the chip back as shown, but try not to break the wood fibers. Then drive the nail home, set the head slightly, apply glue to the chip, and press it back into place. When the glue is dry, smooth the surface with sandpaper, and you will find it extremely difficult to detect the chip.—L. T. E.

LETTER OPENER HAS KNOTTED HANDLE

THE distinctly novel letter opener of copper shown below at the right illustrates how knots can be used for decorative purposes. The blade, which is 5 in. long, is made from copper or, better still, sheet brass, and its surface is given a hand-wrought appearance by beating it with a ball-peen hammer. To make the handle, obtain a 12-in. length of fairly heavy copper wire, heat it to soften the metal, and allow it to cool. Then tie a shamrock knot, which is nothing but an interlocked pair of overhand knots. The loops should come halfway between the extremities of the handle. Flatten the wire ends and bend them so that they will fit around the end of the blade, where they are held by solder. The over-all length of the opener will then be about 8¼ in. Highlight both the handle and the hammered blade with fine sandpaper. Another use for wire knots was described in a previous issue (P.S.M., Mar. '32, p. 84).—E. W. B.



A "shamrock" knot tied in copper wire forms the handle of this decorative letter opener



The cutting is done on the back of a drawing board with a razor blade guided by a metal rule or an old hack saw blade

CUTTING PAPER ACCURATELY

AN ACCURATE paper cutter may be attached to the underside of a drawing board, out of the way except when needed. Near one of the long sides of the board, two cheap rulers are fastened with brads end to end as shown. These form the paper stop and give the measurement from either end of the paper—an advantage over the guillotine type of cutter. A steel rule or a hack saw blade forms the cutter guide and has a hole in both ends to drop on two headless nails that protrude slightly from the surface of the board. A section of the paper stop is cut out to allow the cutter guide to rest flat on the board; and, of course, the right edge of the guide must register with the zero mark of the two rulers and be set at 90 deg. to them.

Slide in the paper and use a razor blade to do the cutting. For dark room work, push pins are stuck in the board at required distances to facilitate cutting in a very weak light. This arrangement allows photo prints and drawings to be trimmed accurately.—IVAN GROSVENOR.

GLASS VIALS KEEP RAIN OFF SEED LABELS

SMALL glass vials or bottles such as those in which photographic chemicals are sold can be used as a cover for plant labels and to protect them from the weather. The name of the plant is cut from the seed package and inserted in the bottle as shown in the photograph in the oval above. One end of a small stick is whittled to fit in the bottle mouth; the other end of the stick is pointed so it can be pushed into the ground. Seed labels protected in this manner will remain readable indefinitely. When the ordinary type of plant sticks are used with the plant names written on in pencil, the lettering can be coated with transparent household cement, which forms a waterproof covering.—RAY J. MARRAN.

June 1932

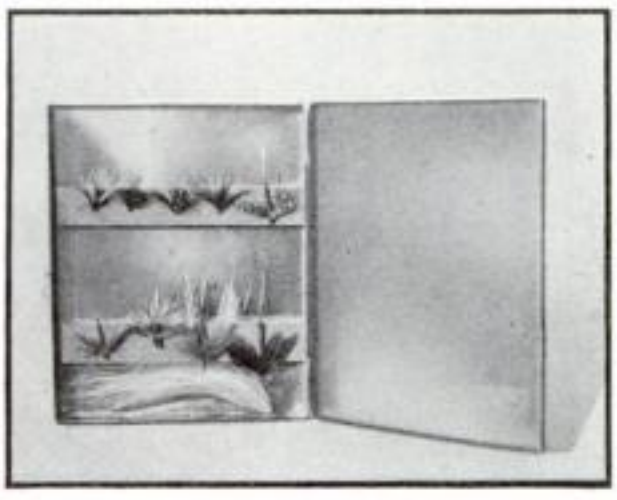
PEA VINES GET SUPPORT ON BRUSHWOOD HUNG FROM LONG WIRE

TO PROVIDE a trellis for peas, many gardeners cut short lengths of brush and stick them into the ground, but a better way is to set a solid post at each end of the row of peas, stretch wire from one to the other about 4 ft. above the ground, and hang the brush, tips down-

High winds will not disturb vines supported in this way

ward, on this wire. The tiny vines quickly lay hold of the slender tips of the brush and soon there is a regular hedge of pea vines. Best of all, they are securely held at the top when the vines grow large and heavy. High winds cannot blow them flat, and the brush and vines remain upright until taken down.—CORA HAMILTON.

FISHERMAN'S CASE FOR CARRYING FLIES

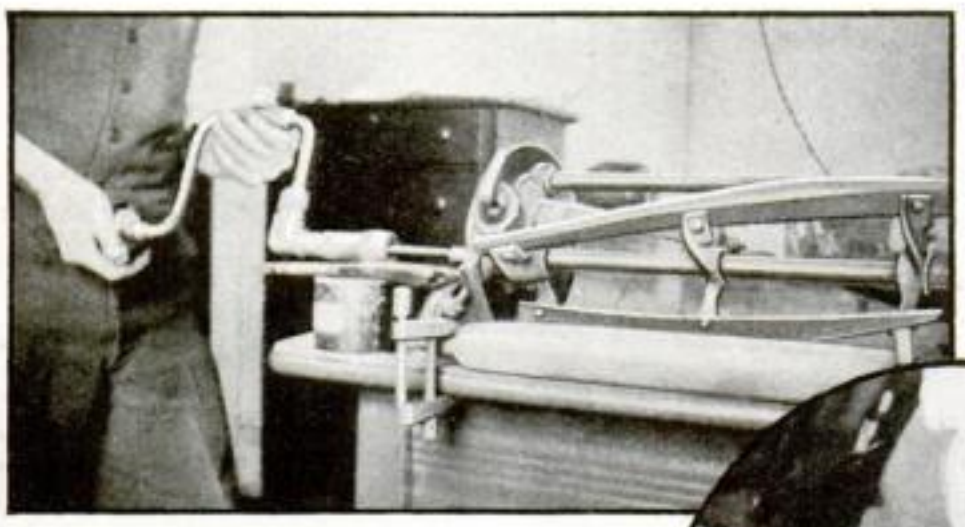


Two strips of insulating board are cemented across a flat tin box to form this fly case

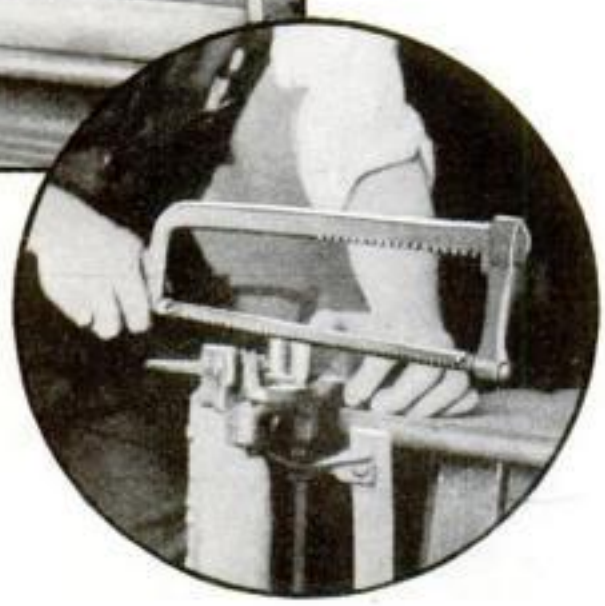
ANY angler who ties his own fan wing flies can make an excellent case for carrying them from one of the flat tin boxes in which cigarettes are sold, a small piece of insulating board such as that made from sugar cane, and a stick of fishing rod ferrule cement.

Cut two strips from the insulating board to fit tightly across the box, reduce their thickness to give clearance under the cover, and cement them firmly in place as shown. Stick the points of the hooks into the strips, and you are ready for the stream.—GEORGE EDWARD DORMAN.

Sharpening and Adjusting your LAWN MOWER



By cutting a slot in the end of the shaft with a hack saw as in photo below, the shaft can be turned by means of a screw driver held in a bit brace as shown at left



A LAWN mower is like a razor—it either cuts or pulls. Even a low priced machine should cut satisfactorily for at least ten years with just a little attention. On a basis of one hour's use weekly, it is usually not operated more than 300 hours during this period.

To sharpen your lawn mower, all you need is ten cents' worth each of No. 80 and 120 emery, a bit brace, and a screw-driver blade. Remove the handle, drivers, and small gears from the shaft. On the average machine the shaft is soft, so with a hack saw cut a slot 1/16 in. deep on one end to take the screw-driver bit. Close in the edges slightly to prevent the blade from slipping. If the shaft is hard or if you have no bit brace, make a crank as shown at *A* in the accompanying drawings or have one made at a repair shop.

The mower should either be clamped on a worktable or bench or fastened as shown at *B*. Adjust the bearings if necessary. Then mix the two grades of emery separately with machine oil to form a medium thick compound. Apply a sufficient amount of the No. 80 mixture to the cutting edge of the stationary knife, using an old paintbrush. Revolve the shaft backwards at a fairly good speed and stop to spread the lapping mixture about every two minutes. As you proceed, make the necessary adjustments to the bedplate. When a good cutting edge has been obtained on all blades, apply the No. 120 compound several times.

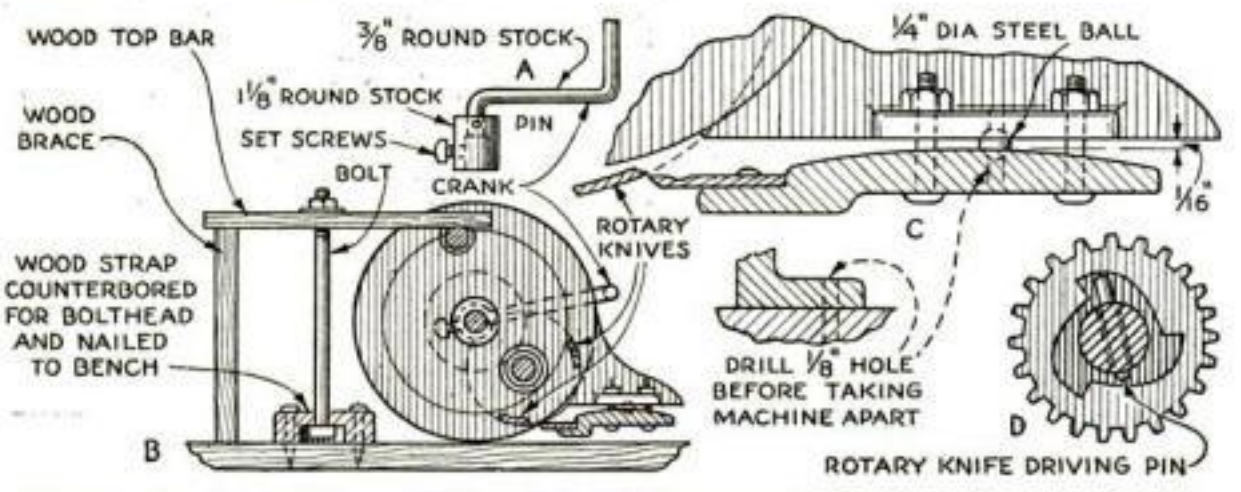
If it so happens that after several sharpening operations the edges of the rotary blades become too wide, chalk them up for guidance and back them off slightly to the cutting edges, using a fine file. Any lawn mower in average condition can thus be ground in fifteen minutes.

When a machine has been neglected for some time, there are several details that should be checked up. It is useless to do any sharpening if the bearings are in bad shape. These generally consist of steel split bushings, which are taken up for wear by adjusting screws on the housings. After a certain length of time, this causes the shaft to be out of alignment, and the machine will not cut even if the blades are sharp. To overcome this trouble, take the machine apart and remove the bushings by releasing the set screws. Fit a piece of shim stock about .006 or .008 in. thick inside the bore, leaving a space for the set screw; then drive the bushings back into place. This will easily correct the bad alignment of the shaft.

Many mowers have a poor method of adjusting the bedplate. A simple improvement, which is in line with high-priced machines, is suggested at *C*. Drill a ⅛-in. hole as indicated. Remove the bedplate and spot the locations with a ¼-in. drill so that a ¼-in. steel ball will leave a clearance of 1/16 in. as shown. This will allow the bedplate to be adjusted with great accuracy and will help insure a satisfactory sharpening job.

At times one finds that the rotary knives act as if they were slipping or pulling from one end only. The trouble can be located as suggested at *D*. The small pins that drive the shaft get loose and by working back and forth on the prongs of the gear, they become worn so short that they drive intermittently. These may be replaced without difficulty.

Sharpen a lawn mower once a month, overhaul it once a year, keep it in a dry place, and you will find it much easier to keep your lawn well trimmed.—H.J.C.



Drawings showing special crank *(A)*, a rig for holding mower during sharpening operation *(B)*, how to improve the method of adjusting the stationary blade *(C)*, and rotary knife pin *(D)*

ROLLING DRAWERS BUILT TO FIT UNDER BENCH

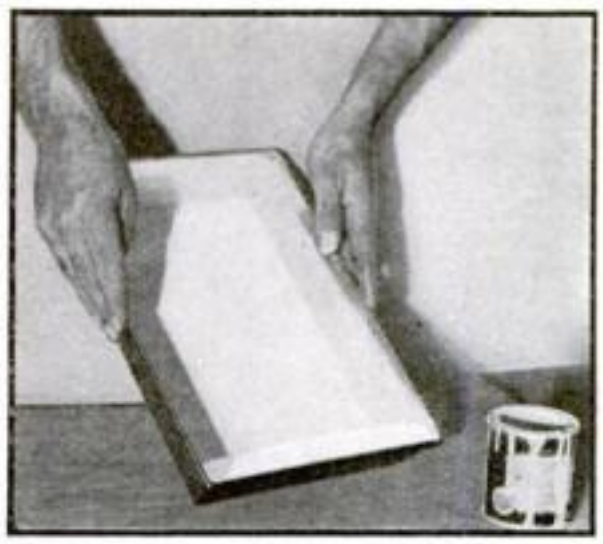
Old packing boxes fitted with casters make handy rolling drawers for under the bench

THE space under an open workbench is usually crowded with a jumble of materials or tools, which are difficult to get when needed. A much neater and more convenient way to use this space is to construct deep drawers or boxes with handles on the front and equip each of them with a set of casters. Then the desired drawer or box can be easily rolled out into the open so that its contents are readily accessible. A set of suitable casters can be bought for a few cents; and the drawers can be old packing boxes, cut down and subdivided.—JOHN C. WORKLEY.

AN EXCELLENT colorless, quick-drying cement for airplane model work can be made easily by dissolving about 4 sq. in. of ⅛ in. thick sheet celluloid in 1 oz. of airplane nitrate dope thinner or acetone. —EDWIN T. HAMILTON.

June 1932

DEVELOPING TRAYS MADE FROM BAKING TINS

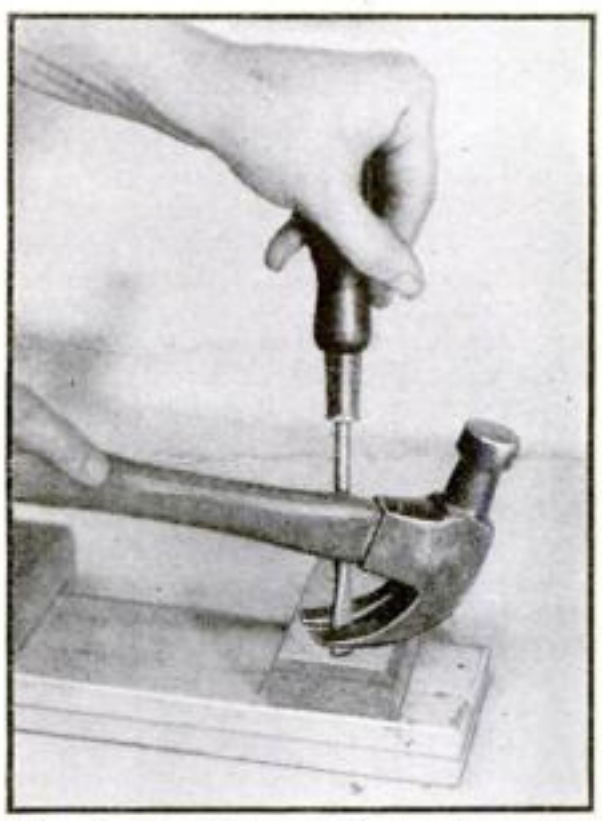


THE amateur photographer who makes enlargements requires at least three large trays for developer, hypo, and wash water. Enameled or composition trays are expensive and glass trays are heavy and easily broken, but a satisfactory substitute can be made in an emergency by lacquering inexpensive cake tins.

First wash the tin with a small quantity of lacquer thinner and remove all dust and lint. Pour about half a pint of white lacquer into the tin and carefully tip it to flow the lacquer all over the inside. Pour the excess lacquer back into the can. Allow the tray to dry for one hour and repeat the process. The outside may be coated by brushing on a heavy coat of lacquer.—EVERETT EAMES.

HAMMER ADDS LEVERAGE TO SCREW DRIVER

TIGHTENING up the last few threads of a screw in hardwood often requires considerable effort. It is not good practice as a rule to use a wrench or other tool to gain additional leverage, but the claw of a hammer may be slipped over the flattened end of the blade as shown to aid in turning the screw driver provided care is taken not to apply so much force as to damage the blade or screw head.—R. W.



The claw of the hammer is slipped over the flattened point of the screw driver blade

HOW TO HANG FABRIC WALL COVERINGS

MANY handy men who can do a good job of hanging wall paper in their homes hesitate to apply wall canvas, muslin, or other fabrics used either for reënforcing cracked plaster or for giving a permanent decorative treatment. They do not know how to make perfect seams or joints between the strips of wall cloth, although they realize that in all other respects the cloth covering is pasted to the wall the same as wall paper.

The making of perfect joints, however, is easy. First, apply the paste to the wall and hang a strip of the dry fabric on the wet paste, smoothing it out with a wall paper smoothing brush. Trim the top edge of the fabric square and butt it against the picture molding, but let the bottom edge lap over the baseboard 2 or 3 in. and trim it later. Hang the second strip the same way and lap the edge over that of the first strip about 1 in. Continue to hang all the strips.

In the case of oilcloth or oil-painted fabrics, allow the paste to set about half a day before trimming the seams. Unfilled muslin and some other unfinished fabrics should be coated with glue size and allowed to dry so as to shrink the fabric before the joints are trimmed. After applying the size in such cases, pull the lapped edges of the fabric loose; then, as soon as the size is dry, paste these loose edges and brush them down, ready for trimming.

With the aid of a yardstick, draw a pencil line on the lapped edges of the fabric about ½ in. from the edge. Then lift the bottom edge of the lapped fabric and cut through both thicknesses at once with small shears. The type of shears used by barbers is satisfactory for this work. Pull off the loose trimmings and paste down the joint so that the edges fit perfectly.

A still easier method of trimming is to use one of the new tools into which a safety razor blade may be inserted and which has a little metal foot on the bottom of the tool that slips under the lapped fabric edges. An accurately matched seam is obtained merely by pushing the tool along the pencil guide line from bottom to top as illustrated in the photograph above. The two scrap pieces are removed and the edges, which will butt perfectly, pasted down.—F. N. VANDERWALKER.

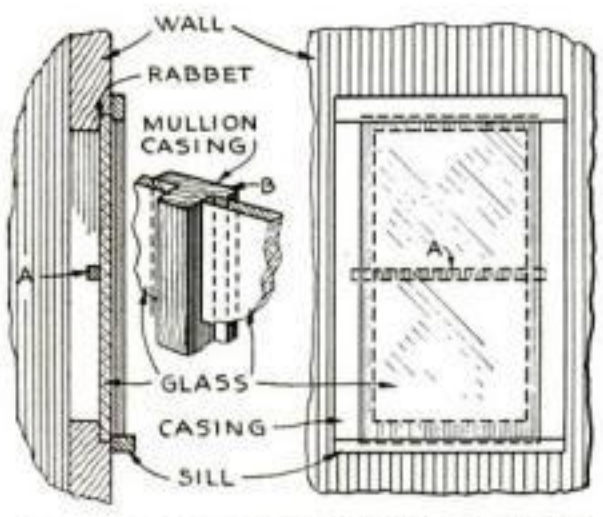
Drawing a pencil guide line down the center of the overlapped edges

A special tool for trimming the edges so as to leave a well-matched joint

REALISTIC WINDOWS FOR MINIATURE HOUSES

A SIMPLE way to make realistic windows for a house model, doll's house, or toy garage is shown below. When the side walls have been prepared, the window openings are marked and cut out. Then these openings are rabbeted around the outside to a depth equal to the thickness of the glass and to a width of about ⅛ in. except at the bottom, where the rabbet should be somewhat wider. Notches are cut halfway up to receive the crossbars as shown at *A*, and the crossbars are fitted and glued. The faces of the rabbets are next painted black, or any color desired, to represent the sash. The glass is then cut and set in, and the sill and casings are nailed or glued on in such a way as to lap over the glass about 1/16 in.

Mullion or multiple windows can be made in several ways. One is to prepare single-piece dividing strips as shown at *B*, fit them in the openings, and set the glass in each division separately. Another is to use flat pieces very similar to the crossbars and cut one piece of glass to fit the entire opening; then other strips to represent the mullion casings are placed over the glass and glued to the casing.—H. T.



A cross section and outside view of a plain window, and one way to make dividing strips

Sealing Wax

used as a finish on unique TABLE LAMP

By Edwin M. Love

The finished lamp and, above, how the sealing wax was applied in the lathe. Bronze, red, blue, and black were used

BEAUTIFUL finishes in turned work are possible if colored sealing wax is used. It is not applied in solution or by heating it until liquid, but merely by pressing the stick against the whirling spindle. The heat of friction melts the color, causing it to adhere in rough circles that cool instantly and give a variegated and distinctive texture to the surface.

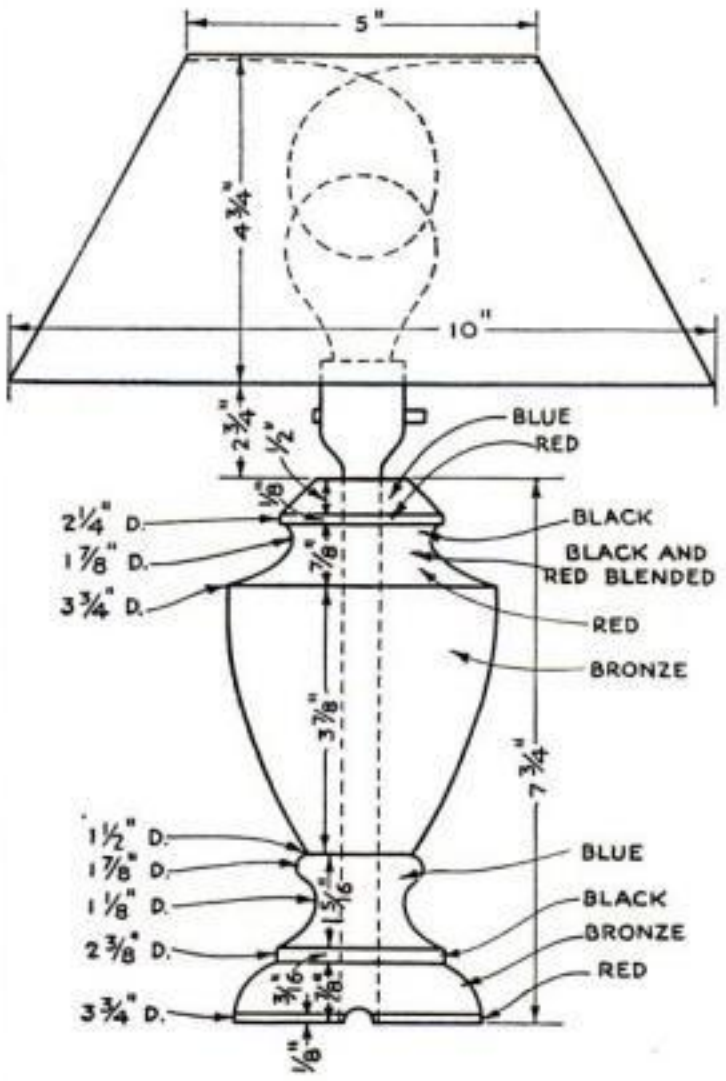
The lamp illustrated is an example of this treatment. For the standard, mount a piece of rough 4 by 4 by 10 in. wood in a lathe and turn it to a cylinder with a gouge. With a pencil pressed against the whirling piece, mark the points where the various diameters are to be measured. Set the calipers 1/16 in. larger than these diameters; then hold the calipers with the left hand, and cut straight in with a cutting-off tool held in the right hand. In this way roughly establish the sizes. Work the standard to the desired shape with the gouge.

When cutting coves, use a small gouge on edge on the tool rest, the tip pointed toward the center, and gradually twist the blade flat as it approaches the correct depth. The finishing cuts on beads and wide spaces should be done with a skew chisel, but if this seems too difficult, scrape them smooth and finish with sandpaper.

Sealing wax in several colors can be obtained at any drug or stationery store. To apply, simply press it against the work, preferably with the stick supported on the tool rest. In a few seconds the wax will start to adhere, and the stick can be moved from one side to the other, coating as it goes.

The writer used bronze as the body color, with decorations of dark red, dark blue, and black. Trim the corners by holding a cloth against the whirling standard. The red stripe at the bottom is made by turning off the bronze, exposing fresh wood to be waxed. Put black on the upper cove and red on the broad top, blending the two where they meet.

A conical shade about 10 in. in diameter and 4¾ in. high, decorated to match, should be used.

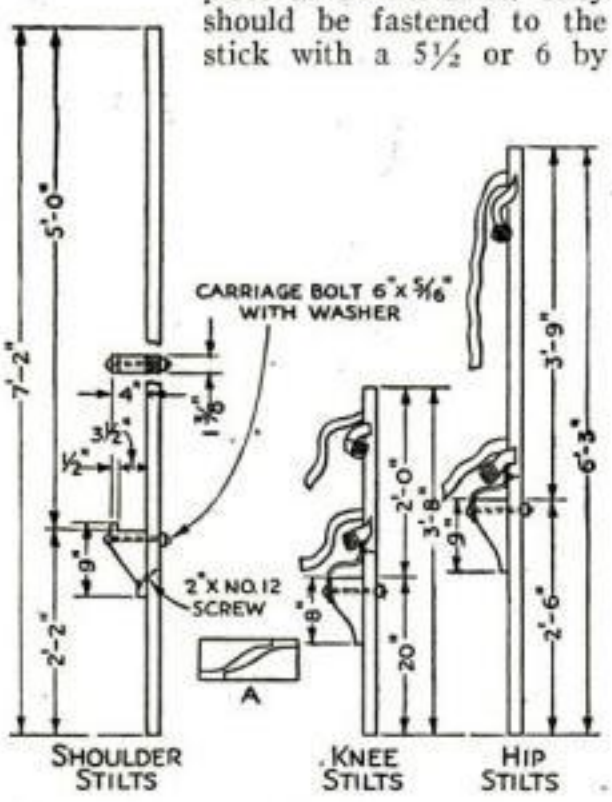


Dimensions of the lamp as made by Mr. Love and a suggested color scheme. The shade should harmonize

THREE TYPES OF STILTS FOR BOYS

THOSE boys who have asked how to make safe and serviceable stilts will find three suggestions in the accompanying drawings. The dimensions are only approximate and may be varied to a considerable degree. The most important thing is to fasten the steps securely.

The stick should be about 1⅜ in. square. If it is less than 1¼ in., it will not be strong enough. The steps may be cut from a block of the same thickness as the stick, two being made from one piece as shown at *A*. They should be fastened to the stick with a 5½ or 6 by 5/16 in. carriage bolt and washer. A 2-in. wood screw inserted near the bottom will prevent the step from turning on the bolt. The steps may be raised from time to time as the user gains confidence and becomes more experienced.



In making a pair of stilts, the important thing is to fasten the two steps securely

Shoulder stilts are the safest, and the beginner may make the stick shorter and the step lower than shown, if he wishes. Knee stilts are for the more experienced stilt walker. Since they are strapped to the leg, with another strap to hold the foot in place on the step, a careless or unskillful movement may result in a bad fall. This is also true of hip stilts.—C. A. K.

DRAFTING OUTFIT PUT INTO NOTEBOOK

A large triangle and two hardwood guide strips take the place of a bulky T-square

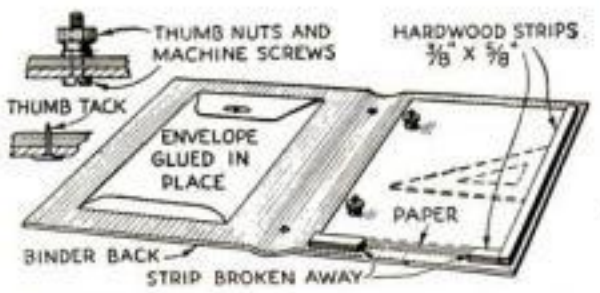
AN ORDINARY loose-leaf notebook of the type commonly used in schools and in colleges can be made into a portable drafting board, which will prove useful to students, estimators, architects, machinists, and those who find it necessary to make sketches on repair jobs. Because of its compact size it will also be handy to have in the home workshop.

The metal ring fixture is removed from the notebook binder by knocking out the rivets. Two hardwood strips, ⅜ by ⅝ by 11¼ in. and ⅜ by ⅝ by 8¼, are sanded smooth and perfectly square, then given a thin coat of shellac. These are fastened to two edges of the binder with small tacks and glue. They should form an accurate right angle. A large triangle resting against either the bottom or side straightedge takes the place of a T-square.

Drawing paper, bond typewriting paper, or Bristol board can be cut to size and fastened to the board by using two short machine screws and two thumb nuts. The screws are inserted in the binder back with the screw heads on the bottom side. Holes are punched to fit the screws in about twenty sheets of paper or several sheets of Bristol board, which are held in place by the thumb nuts.

For temporarily holding the paper, two thumb tacks can be pushed through the binder back with the points sticking up on the inside. The thumb tacks can be held in place with glue. The drawing paper, as needed, is pushed down on these tacks as indicated below.

A large envelope is glued to the other side of the binder to hold the triangles and pencils when not needed. It would be an added convenience to mark off the two wood strips in fractions of an inch to form rules.—ROBERT J. WILLIAMS.



Machine screws and nuts or thumb tacks can be used to hold the paper in place

CAMERA SHUTTERS

(Continued from page 90)

verichrome film you can work a little earlier or later because of the greater sensitiveness of this type of film. At other times of the day or when the weather is cloudy, you can't take good pictures except by making a time exposure.

A camera of this type is excellent for the beginner. There are no adjustments to make so you can't make them wrong, and if you follow the rule about working only in bright sunlight, you will get a fair proportion of satisfactory pictures.

Once you become really interested in photography, you will not be satisfied to limit your picture taking so rigidly. You will want to take snapshots on dull days, get more detail into your pictures, and in general turn out better work.

Merely buying a more expensive camera will not accomplish this result. You must, in addition, learn how to use it. You must learn how to set the various adjustments on the shutter, learn to gage distance well enough to focus the camera with reasonable accuracy, learn how to estimate the exposure, and so on.

Fig. 4. The shutter of a high-grade camera opened to show the shape formed by the extremely light, fast moving blades

Don't become confused because the shutter on a high-priced camera looks more complicated. Remember that it is the same thing with a wider range of adjustment.

Instead of a single snapshot speed, the better grade shutter may have anywhere from two to eight different speeds besides the time and "bulb" exposures. The iris diaphragm of the good shutter lens has the same effect as the punched sheet metal strip in the simple camera, only instead of three fixed openings, the iris can be set for any opening from the largest permitted by the lens down to a tiny hole that will give the maximum detail on relatively long time exposures.

Look at Fig. 1. It shows one of the latest types of compact pocket cameras. It is fitted with an F/6.3 lens and a modern shutter. My finger is resting on the iris diaphragm adjustment, and the number 11 to which it is set is equivalent to the largest stop on a cheap box camera. At the top of the shutter is the speed adjustment. Note that it is set at one twenty-fifth of a second, again equal to the box camera. You can therefore take this camera just as set and use it as you would a simple box camera and get better pictures because the lens gives greater detail.

Now suppose you want to take a picture and the sunlight is a bit hazy. The light being less effective for picture taking, you will need more of it and so you will push the lever over to 8, which increases the opening so that twice as much light gets through. If the sun is under clouds, push the lever still farther over to 6.3 and thus still further increase the opening or stop.

A shutter of more elaborate type would have the same stops as this but also would have more speed *(Continued on page 102)*

Our June PHOTO CONTEST Offers You

a Chance to Win $10

FOR the most photographically perfect picture of any kind submitted on or before July 1, 1932, POPULAR SCIENCE MONTHLY will pay $10. The only condition is that it must be taken during the months of May and June, 1932, by an amateur. Any type of camera may be used, and the developing and printing may be done by a professional.

Mail both print and negative to the Photographic Editor not later than July 1, and mark your entry "June Photo Contest." You may enter several photos if you wish. No entries will be returned, however, unless accompanied by a self-addressed, stamped envelope.

The $10 prize for the best flashlight photograph entered in the ninth contest in this series (P. S. M., Feb. '32, p. 120) has been awarded to J. M. Guyol, of St. Louis, Mo. The following won honorable mention in the same contest: Ruth Boyd, Ashton, Lee Co., Ill.; George F. Cassidy, New York, N. Y.; Dick Flach, Evanston, Ill.; George C. Friend, Roanoke, Va.; R. E. Lave, Homewood, Ill.; Glen McWilliams, Van Dyke, Mich.; J. E. Maddison, Renton, Wash.; Dwight Pritchard, Avoca, Iowa; M. Rudner, Montreal, Que., Canada; Dominick Terranova, Harrison, N. Y.; Herbert B. Woodling, Cincinnati, Ohio. The winner of the March contest will be announced next month.

CAMERA SHUTTERS—THEIR OPERATION

(Continued from page 101)

adjustments, the finest types giving any desired automatic exposure from two hundredths of a second to a full second. Such a shutter is shown in Fig. 4. This picture shows how the shutter blades open in a star shaped arrangement. All modern shutters above the box camera grade use these extremely lightweight, fast moving blades even when the top speed of the shutter is only a fiftieth of a second. The idea, of course, is to get the quickest possible opening and closing with the shutter wide open for a large portion of the total time the film is exposed.

All shutters above the box camera grade also have a so-called "bulb" exposure. When set at this point, the shutter opens when the lever is pressed and closes when it is released. It is supposed to be used for all exposures so short that the "time" exposure—where the shutter opens on one pressure and closes on the next—is not practical.

I HAVE found, however, that using the bulb exposure on any light camera is almost certain to jar the camera. It is much better to set the shutter on "time," then hold a piece of black cardboard in front of the lens while you open the shutter and wait a second or two for the vibrations to stop, and finally make the exposure by moving the cardboard away from in front of the lens. Figure 2 illustrates the method. At the end of the exposure, move the cardboard in front of the lens and then close the shutter. This method of making short-time exposures works especially well with a box camera or with any camera when the tripod or other support is a bit wabbly and there is any chance of moving the camera if the trigger is touched.

No matter what kind of shutter you have to operate, remember that more pictures are ruined by forgetting to set the shutter or the focusing adjustment than are spoiled by incorrect setting.

If you take a picture of a distant view with the focus set at six feet, you won't get a picture worth keeping, and if you take one on the beach under the blazing sun with the lens wide open instead of stopped at least to 16, you will get a negative as black as the ace of spades.

To prevent such oversights, work out a routine that will apply to your particular camera and follow it each time you take a picture till it becomes second nature. Remember the three S's—set focus—set opening—set speed!

The next and fourteenth article in this series is scheduled for the July issue. If you wish to ask any questions on taking photographs, send them to Mr. Ryder in care of this magazine and inclose a self-addressed, stamped envelope for his reply.

WHEN a pattern is to be used for cutting out a large number of pieces of cloth, paper, or other thin material, it pays to make it from sheet metal and paste or cement sandpaper on one side. The sandpaper gives a good grip for the fingers, and less pressure will be required to keep the pattern from slipping out of place.—JOHN H. FORTHOFFER.

WHY MOTORS DIE ON THE ROAD

(Continued from page 70)

"Don't bother," Gus advised. "Just move it away a couple of inches and wrap it with asbestos. That'll keep the heat out of it. That's the way the new cars are fixed to get rid of vapor lock—a little heat insulation where it's most needed. Sometimes a few sheets of asbestos slipped in around the carburetor bowl will be worth while if it's real close to part of the exhaust manifold.

"Any other suggestions as to what makes cars stop on the road, Jeff?" Gus inquired.

"Sure," Jeff replied. "Lots of people get stuck with busted fan belts. I had one break last year."

"So did I," said Tim.

"But you got home just the same, only with a bit of a delay," Gus objected. "Nobody ever gets stuck with a broken fan belt so long as any water is left in the radiator. When the fan breaks and she starts to boil, you have to stop and let it cool off a bit. Then you can go on till it boils again. That may be a nuisance but at least you always get to a service station.

"A BROKEN fan belt can do a lot of damage if it happens to let go when the car is hitting the high spots. I've seen several radiators ruined and once I saw a distributor head smashed to scrap by the swinging end of a busted belt. It doesn't pay to run a fan belt after it starts to get frayed."

"How about the battery going dead?" suggested Tim. "I've seen lots of fellows stuck with dead batteries."

"That stops cars sometimes," Gus admitted. "But it keeps 'em stopped much more often than it stops them. When a battery is going bad, you usually know it because it won't start the car. If the car once starts, it's unlikely that you'll have any trouble until you stop again. Of course, every time you slow down in traffic, you're depending on the battery for ignition, and I have run across cases where a couple of cells shorted so badly while the car was running that the motor went dead in the middle of the street."

"I can't think of anything else that happens often enough to be worth mentioning," Jeff said after a moment of thought. "Suppose you tell us, Gus."

"WELL," said Gus as he packed up his lunch kit, "if you budding young auto engineers give up the problem, I suppose I'll have to solve it for you.

"The thing that's most likely to stop a car on the road these days is the sight of a hot dog stand and the smell of roasting wienies! Second comes a puncture or a blow-out, and third is the one you ought to have mentioned in the first place—running out of gasoline!"

BIG RAINDROPS FALL 17 MILES AN HOUR

HOLDING the stop watch on rain is a feat recently accomplished by Government scientists. Raindrops during a drizzle fall at a rate of only two and a half feet per second, Dr. W. J. Humphreys of the United States Weather Bureau reports. The bigger drops of a typical "shower" fall at a speed of ten feet per second or more. Highest is the speed of the largest possible raindrop—one fifth of an inch in diameter—which descends at a uniform speed of twenty-five feet per second, or approximately seventeen miles an hour. Rain cannot fall faster than this, since larger drops inherently capable of attaining greater speed would be torn to pieces by the drag of the air through which they passed.

AQUARIUMS MADE FROM OLD OIL CANS

NEAT, practical aquariums may be made at trifling cost and without any special skill with tools by using 1-, 2-, or 5-gal. oil or varnish cans of the square-cornered type.

Rinse the can with gasoline and cut out what are to be the top and four sides of the aquarium as shown. Leave a margin of metal about 1½ in. wide around what is to be the bottom of each side panel, a margin 1 in. wide around the remaining three sides of each panel, and a band ½ in. wide around the top. On each side panel, cut diagonally in for ½ in. as shown. Bend ½ in. of these edges in and back over a thin metal or hardwood strip about ½ in. wide. Lay the can down on a concrete floor or other hard surface and hammer the edges of each of these side panels until flat. This makes the whole tank rigid. Cut diagonally into the corners of the margin left around the top.

These were constructed by Mr. Duncan, chief preparator at the Pennsylvania State Museum

Fasten double thick window glass or plate glass inside the tank with aquarium cement, which can be obtained at any pet shop. Now bend the projecting ½-in. margin of metal at the top over the upper edge of the glass. Brace the glass until the cement is hard by wedging small sticks tightly inside the tank from side to side. The frame may be lacquered or enameled at this stage, then set aside for at least a day.

Cut the baseboard from a piece of wood ¾ or ⅞ in. thick, making it about 1½ in. larger than the bottom of the tank. Bevel the edges, sandpaper them, and apply a strip of quarter-round molding to hold the tank in place. This is mitered at the corners to fit the aquarium exactly and is nailed to the base, forming a rectangular frame or receptacle. Lacquer or enamel the base and give a final coat to the metal part of the tank.

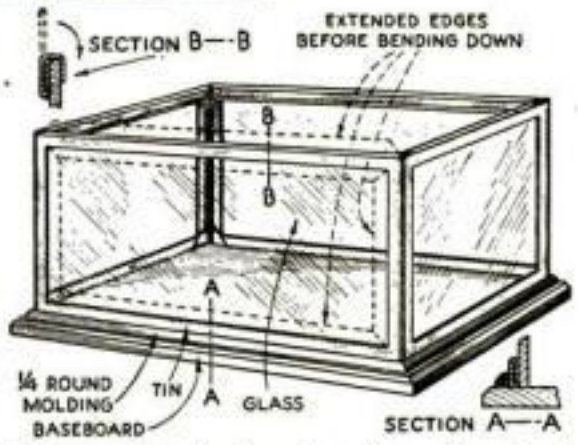


Diagram showing how the oil can is cut out, the glass inserted, and the baseboard made

Three aquariums built by this method have been in use for eight months and not one has leaked a drop.—L. G. DUNCAN.

HINTS ON PAINTING GALVANIZED IRON

Galvanized iron pipes and gutters last much longer when they are kept properly painted

GALVANIZED roof gutters and downspouts are never certain of long life unless kept well painted. Even a pinhole through the zinc coating gives ample opportunity for rust to start. New galvanized iron, however, has such a smooth surface that it is difficult for even good paint to gain an anchorage on it. All new galvanized surfaces should be coated, before painting, with a solution composed of 4 oz. of copper acetate, copper chloride, or copper sulphate in 1 gal. of hot water.

After galvanized iron has weathered for a year or more, the surface is not so slick and a first-class outside paint, if carefully applied, will give good service on it without the above treatment. Any rust spots should be sandpapered bright.

Better protection is gained by applying a first coat of some rust inhibitive paint such as red lead, blue lead, graphite, or iron oxide ready-mixed metal paint. The color of some rust inhibitive paints is unpleasant, but it can be altered by the addition of a little burnt umber oil color for brown, chrome green for green shades, and lampblack for grays. Over such paints any high-grade house paint such as is used on wood will give the desired final color as well as adequate protection.

The inside of new pipe can be painted by pulling a paint-soaked sponge through with a cord. An even better job can be done before the pipe has been put in place by plugging one end with a rag and pouring a gallon or so of paint into the section. By turning the pipe and pouring the paint out again, the surface can be thoroughly flooded.—F. N. V.

STIRRING a can of paint is easy if you bend a stiff wire to form a suitable paddle and spin it in the paint by means of a hand drill.—T. R. WATTS.

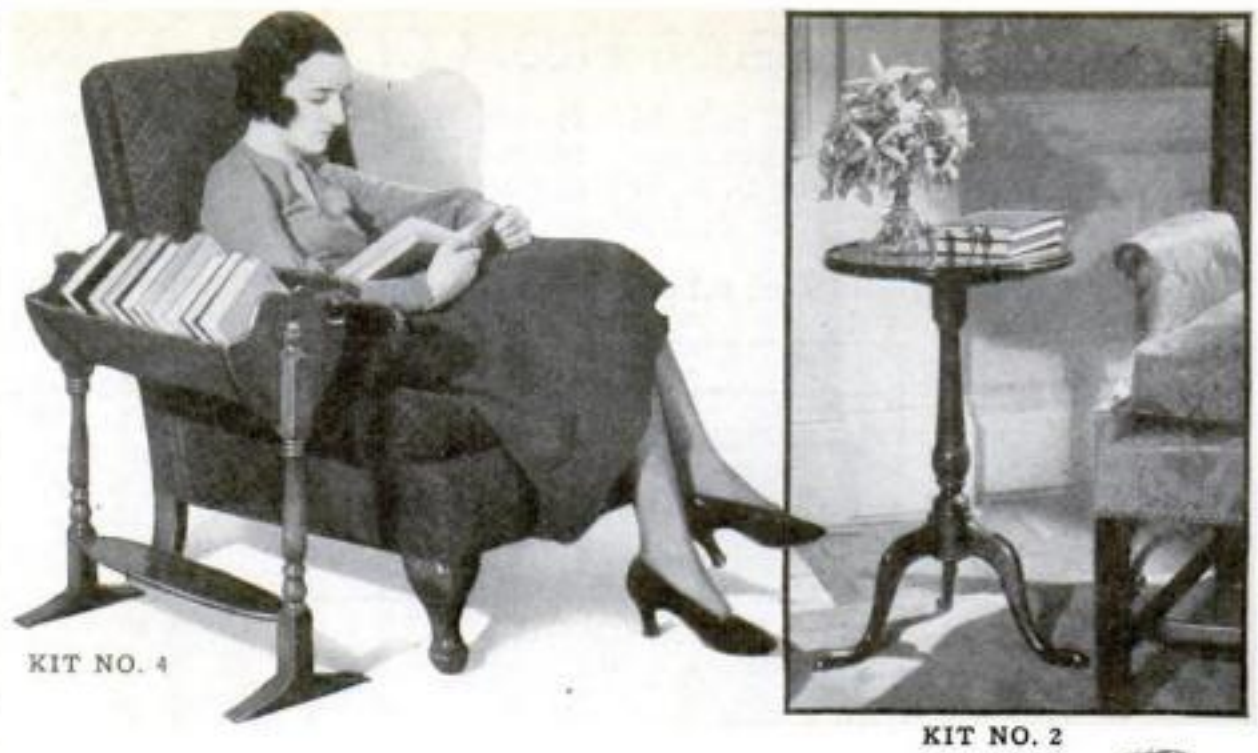
CRACKS or HOLES

in plaster or concrete

quickly repaired at little cost

Ready-mixed Patchers and simple directions make it so easy you can do it yourself.

Anyone, even without experience or special skill, can make permanent and thoroughly satisfactory repairs in plaster or concrete, without the expense of hiring outside help. If the cracks or holes to be mended are in plaster walls or ceilings, use Rutland Patching Plaster. If they are in portland cement or concrete walls, walks, driveways, cellar floors, etc., use Rutland Concrete Patcher. Each comes in a handy package and each contains correct ingredients ready-mixed. Just add a little water and apply. Get these products at your paint, wall-paper or hardware store and use them today. Made by the Rutland Fire Clay Co., Rutland, Vermont.



KIT NO. 4

KIT NO. 2

Our Construction Kits Enable You to

Assemble Beautiful Furniture

AT LOW COST

KIT NO. 1

YOU probably have in your home some especially prized piece of high-grade custom-built furniture. If so, you know how superior it is in appearance to ordinary "store" furniture. What you perhaps do not realize, however, is that you can assemble equally fine furniture yourself by making use of the new Popular Science Homecraft Guild construction kits, which are now made in four designs.

KIT NO. 3

These are the four Guild kits. A few typical comments from readers who have already built them are: "Perfect in material. Precision of cutting and turning is remarkable." "Must compliment you on how perfectly each piece is cut." "I am more than pleased." "What a table!"

Each kit contains all the necessary materials for assembling and finishing a piece of beautifully designed maple or mahogany furniture. The wood is of the best quality and perfectly machined; all the necessary dowels, screws, and hardware are included; and there are three cans of finishing materials in each kit for the Guild's remarkable new three-step finishing process.

The designs are shown above. Kit No. 1 is a maple butterfly table of Colonial design with an oval top 17 by 22 in., and 22½ in. high. Kit No. 2 is a solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Kit No. 3 is a tilt-top coffee table 21 in. high, the top being 19 by 28 in. It can be had in either maple or mahogany. Kit No. 4 is a solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all.

As the Guild is a service organization, do not hesitate to send your comments

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me the following kit or kits, for which I inclose $..... (or send C. O. D. ☐)

- ☐ **No. 1.** Maple butterfly table **$6.90**
- ☐ **No. 2.** Mahogany tray-top table **$5.90**
- ☐ **No. 3.** Maple tilt-top coffee table **$7.15**
- ☐ **No. 3A.** Mahogany coffee table **$8.15**
- ☐ **No. 4.** Mahogany book trough **$5.30**

All prices are 50 cents higher west of the Mississippi River because of heavy shipping charges.

It is understood that these prices include the machined wooden parts, hardware, finishing materials, and shipping charges, and that if any kit should prove unsatisfactory, I can return it within ten days and the amount paid will be refunded at once. Complete, illustrated instructions accompany each kit. This offer is made only to readers in the United States.

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(Please print name very clearly.)

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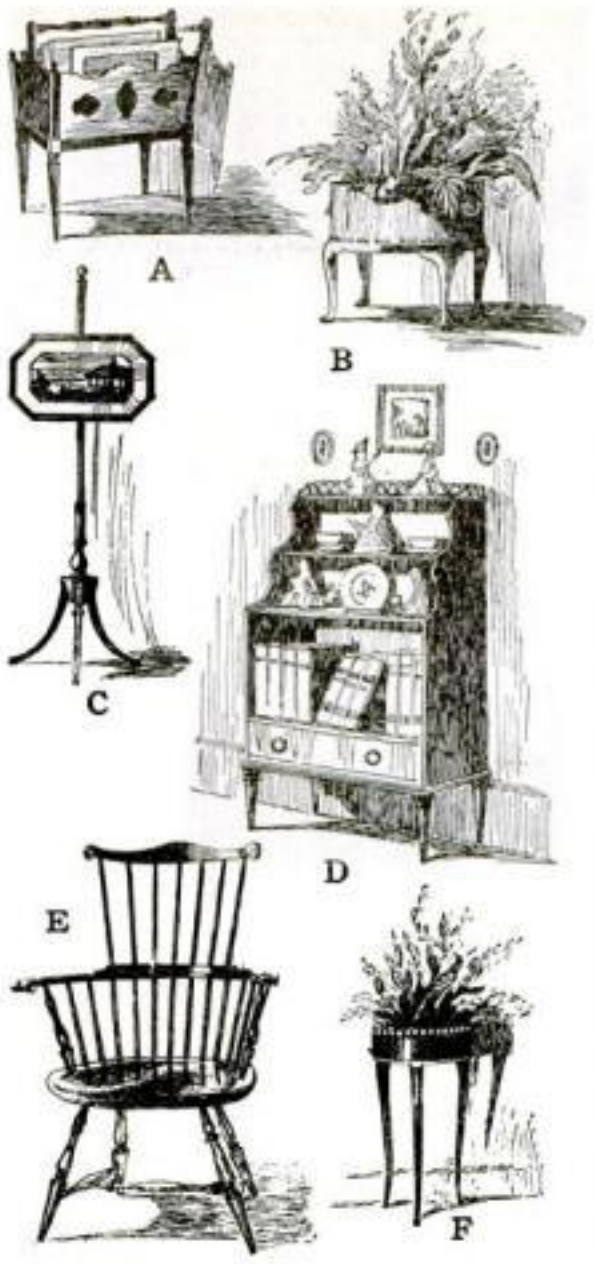
1. That the names and addresses of the publisher, editor, managing editor, and business managers are Publisher, Popular Science Publishing Co., Inc., 381 Fourth Avenue, New York, N. Y., Editor, Raymond J. Brown, 381 Fourth Avenue, New York, N. Y., Managing Editor, Raymond J. Brown, 381 Fourth Ave., New York, N. Y., Business Manager, A. L. Cole, 381 Fourth Avenue, New York, N. Y. 2. That the owners are: Popular Science Publishing Company, Inc., 381 Fourth Avenue, New York, N. Y.; Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 230 Park Ave., New York, N. Y.; Oliver B. Canen, 381 Fourth Avenue, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Ada B. Wilson, 683 Springfield Avenue, Summit, N. J.; A. L. Cole, 381 Fourth Avenue, New York, N. Y.; John Nichols, 381 Fourth Avenue, New York, N. Y. 3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: none. 4. That the two paragraphs next above giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear on the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) A. L. Cole, Business Manager.

Sworn to and subscribed before me this 18th day of March, 1932.

Esther Eyl, Notary Public, Kings County Clerk's No. 57, Registry No. 2065, New York County Clerk's No. 158, Reg. No. 2E117.

(Seal) My Commission expires March 30, 1932.



and suggestions. What pieces would you like to see made up in kit form? Six sketches by William Zaiser, the Guild's expert designer, are reproduced above. If you will study these and then take the trouble to fill out the accompanying ballot and send it to the home workshop editor, who is also secretary of the Guild, it will help in reaching a decision as to what kits to prepare next.

Home Workshop Editor,
Popular Science Monthly,
381 Fourth Avenue, New York, N. Y.

I have checked below the piece or pieces of furniture I should prefer to make from Popular Science Homecraft Guild construction kits.

- ☐ A Magazine stand or Canterbury in mahogany, 15 in. long, 21 in. high
- ☐ B Flower or fern stand in walnut, oval in shape, 18 in. long, 19 in. high
- ☐ C Lamp screen in walnut or mahogany, 58 in. to top of staff
- ☐ D Bookcase or curio case in mahogany, 24 in. wide, 32 in. high
- ☐ E Windsor chair in maple, elm, and hickory
- ☐ F Flower table in walnut, 12½ in. in diameter, 27 in. high

Other pieces I would like to see made up in kit form:

.....

.....

☐ Please send me the price and an order blank for the kit marked ..... as soon as it is ready

Name .....

Address .....

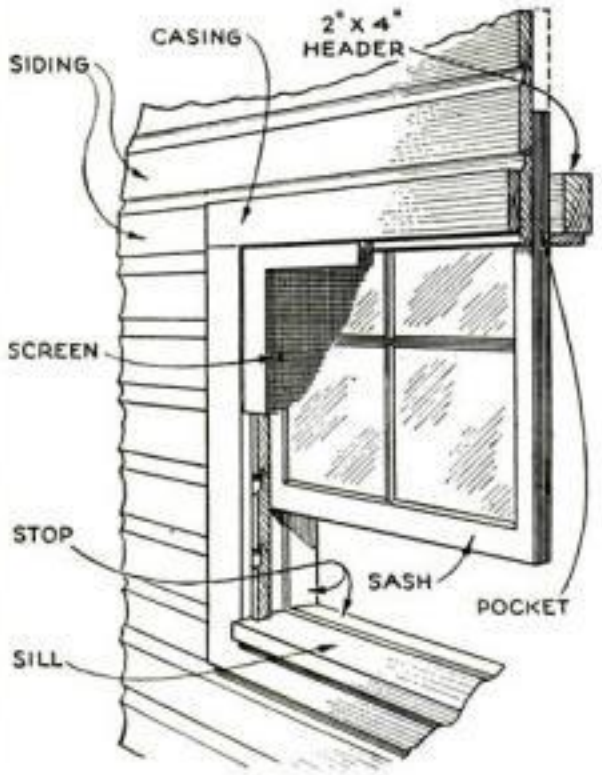
City ..... State .....

A definite program for getting ahead financially will be found on page four of this issue

LOW-COST WINDOWS FOR SUMMER COTTAGES

ONE of the simplest types of window for use in summer cottages, play houses, and other small frame buildings, is shown in the accompanying sketch. It is weather-tight, neat in appearance, and easy and inexpensive to install. The sash, which slides upward into a pocket at the head, needs no special frame. The only requirement is that there be sufficient space to allow the window to slide up.

Ordinary four-light stock sash is used. The wall construction is of siding on 2 by



With this sliding sash construction, it is not necessary to use a regular window frame

4 in. studs. Space the studs at the window ⅛ in. wider apart than the width of the sash, thus forming the two jambs. At the top of the window, turn the "two-by-four" header edgewise to provide a slot for the sash to slide through into the space, or pocket, above.

The siding projects ½ in. beyond the studs to serve as the outside stop between sash and screen. The outside casing is set back ½ in. at the sides and the top to receive the screen frame.

Around the inside of the window, a ½ in. thick stop is used.—JAMES THOMAS.

PREVENTING OVERFLOW OF STOCK TANK

WHEN a gas engine is used to fill a stock watering tank, the problem of preventing an overflow can be solved in a very simple way. Obtain two strands of insulated wire long enough to reach from tank to engine. Uncover about 1 in. at one end of each wire. Run these bared ends over the edge of the tank, turning them down so that about 1 in. will be covered by the water before the tank overflows. Staple the wires to the edge of the tank to keep them in this position, and see that the bared ends are as close together as possible without actually touching. The other end of one wire is hooked to the magneto, and the second wire is grounded to the engine. As soon as the tank becomes so full that the water covers the bared wire ends, the engine stops automatically.—WILL E. SMITH.

June 1932

HOW TO CONSTRUCT A MUFFIN STAND

(Continued from page 77)

List of Materials

No.	Part	T.	W.	L.	No.	Part	T.	W.	L.
4	Legs *A*	½	1½	33½	2	Lower shelf supports *L*	½	1 7/16	4⅞
1	Top shelf *D*	½	9⅞	15	2	Shelf support spreaders *G*	½	¾	10
1	Lower shelf *C*	½	9⅞	19	1	Handle *E* (to be turned)	1¾	1¾	12
2	Shelf hinge brackets *B*	½	1¾	10	2	Spreaders *F*	"	1¼	1¼	12
4	Hinge bracket braces *J*	½	1¾	1¾	2	Rosettes *H*	"	½	2	2
2	Upper shelf supports *K*	½	1 3/16	3⅜	14	1½-in. No. 8 roundhead wood screws				

All dimensions are given in inches.

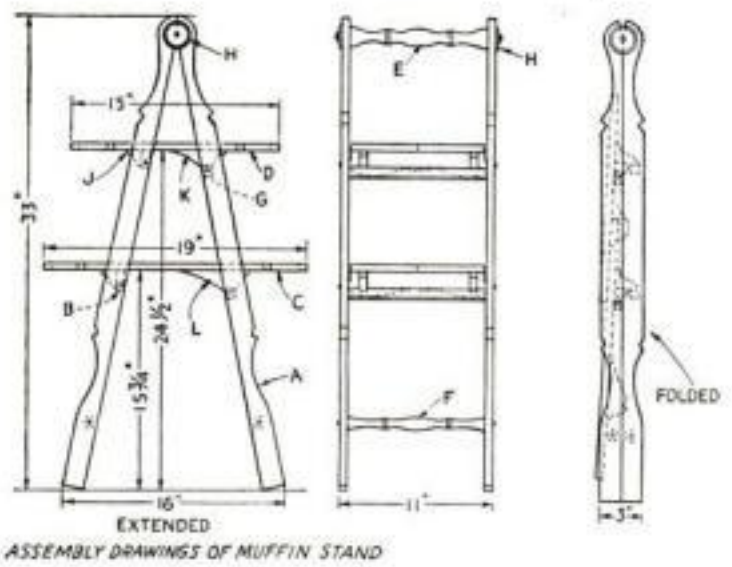
should be used if the piece is being made of a high-grade cabinet wood. The screw heads should be hidden with plugs.

When these remaining pieces have been made and the shelves assembled, first put in the shelf support spreaders *G*, then install the shelves by inserting the screws on which they hinge. At this point a few inaccuracies in workmanship may have to be corrected, but a little cutting or shimming will easily fix these.

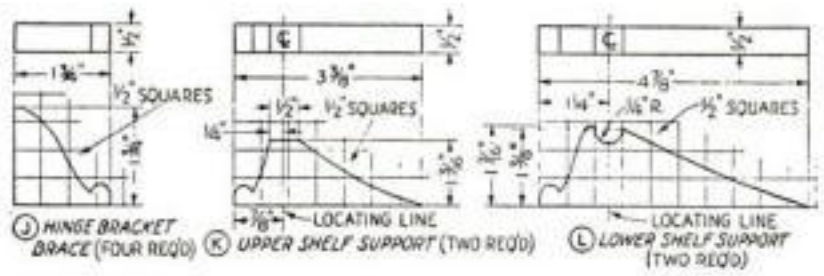
For finishing, the piece should be completely taken apart and each part handled separately. This is the only satisfactory way in which to do the job.

The piece shown was first sanded smooth with No. 0 sandpaper, then dampened to raise the grain, allowed to dry thoroughly, sanded again with No. 00 paper, stained, shellacked, dried for two days, sanded with No. 00 paper, and given three coats of high-grade varnish. Each coat was rubbed down before the next was applied, and a final polish was given with wax.

If you wish to work from larger drawings than those given in the magazine, send 75 cents to the POPULAR SCIENCE MONTHLY Blueprint Service Department, 381 Fourth Ave., N. Y., and ask for special Blueprints Nos. 173A and 174A.



ASSEMBLY DRAWINGS OF MUFFIN STAND



Assembly drawings and details of hinge brackets and shelf supports. Larger drawings are available in blueprint form

GUILD OFFERS KIT FOR THE MUFFIN STAND

YOU can obtain all the materials for making the muffin stand (except the finishes) from the Popular Science Homecraft Guild. Two woods are available—selected sugar pine and birch. Mr. Wittick points out the advantages of pine in his article, but some readers will prefer a hardwood. Birch, especially if of the high grade contained in these kits, is an excellent wood for the purpose and can be finished to look like maple, mahogany, or walnut.

Each kit contains the wood cut as indicated in the list of materials above and also the necessary roundhead wood screws. Unlike other Guild kits, however, this one has not been machined in any way. It is for the man who wishes to do all the work himself, but who wants to start with exactly the right materials and who does not care to pay for a lot of waste wood, as is almost invariably the case when buying from a local lumber yard.

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me all the materials for the muffin stand as listed above in the wood checked.

☐ Sugar pine ☐ Birch

☐ I inclose $2.90 (or $3.40 if shipment is to be made west of the Mississippi River).

☐ Send C. O. D.

☐ Also send me special Blueprints Nos. 173A and 174A, for which I inclose 75 cents extra.

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(Print very clearly)

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City..... State.....

Note: This offer is made only to readers in the United States.

BLUEPRINTS *for Your Home Workshop*

For this month's new blueprint projects see pages 71, 74, 77, and 78

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions which appeared at the time the project was first published. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given.

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Bremen (Junkers, 3-ft. Flying), *89-90*	$ .50
Combination, 20-in-1, *135-136*	.50
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Rise-off-Ground Tractor, 3-ft., *50*	.25
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Seaplane, Morris (Record 12½ min.), *102*	.25
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Canoe, Sailing Outfit, *25*	.25
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With full size patterns	2.00
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With full size patterns	2.00
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With full size patterns	2.00
16-ft. Rowboat-Motorboat, *149-R*	.50
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Lindbergh's *Spirit of St. Louis*, *67*	.25
Play Table, Pullman, *28*	.25

Miscellaneous

Arbor, Gate, and Seats, *9*	.25
Baby's Crib and Play Pen, *26*	.25
Garage, One-Car, Pergola, *23*	.25
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Swing, Porch, *10*	.25
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Workbench, *15*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

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Coming Features

HOW to build the *Sportboat*, a 15½-ft. runabout designed and built especially for POPULAR SCIENCE MONTHLY readers.

PLANS for a flying model of another famous war plane, the Nieuport, by J. Danner Bunch.

OUR WHALING MODEL KIT WILL SAVE YOUR TIME

IF YOU have ever tried to buy the materials for building a ship model, you know how much "shopping around" is required before you can get just what you want and how the cost runs up out of all proportion to what it should be. You have to buy far more of each item than you can use, and frequently you have to be content with more or less unsatisfactory substitutes for the proper materials.

To put an end to this universal difficulty, the Popular Science Homecraft Guild has assembled complete kits of materials for building the new whaling ship model (see pages 83 to 85 of this issue). Each kit contains clear sugar pine for the hull, fine cabinet hardwood for the base, thin hardwood and plywood stock for the deck fittings, hardwood dowels for the masts and spars, boxwood for the deadeyes and blocks, sheet brass, copper sheathing, five sizes of brass and copper wire, four sizes of twisted linen fishing line of the best quality, 110 in. of fine chain in two sizes, celluloid or fiber for making the tops and similar parts, escutcheon pins, muslin, thread, and other essentials—in fact, all the raw materials except the paints. A more fully itemized list was given in the first installment of the *Wanderer* series (P.S.M., Apr. '32, p. 78).

These materials, together with four blueprints which show all parts of the model full size and are alone worth $1.00, will be sent to any reader in the United States east of the Mississippi River for $6.90 and west of the Mississippi for $7.40. The package is a heavy one and the extra charge of 50 cents for shipments west of the Mississippi is necessary to meet part of the shipping cost.

If you intend to build this beautiful new model, take advantage of this special time- and money-saving offer at once.

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me all the materials (except paints) required for building a model of the whaling ship *Wanderer*, and also Blueprints Nos. 151, 152, 153, and 154.

☐ I inclose $6.90 (or $7.40 if shipment is to be made west of the Mississippi River).

☐ Send C. O. D.

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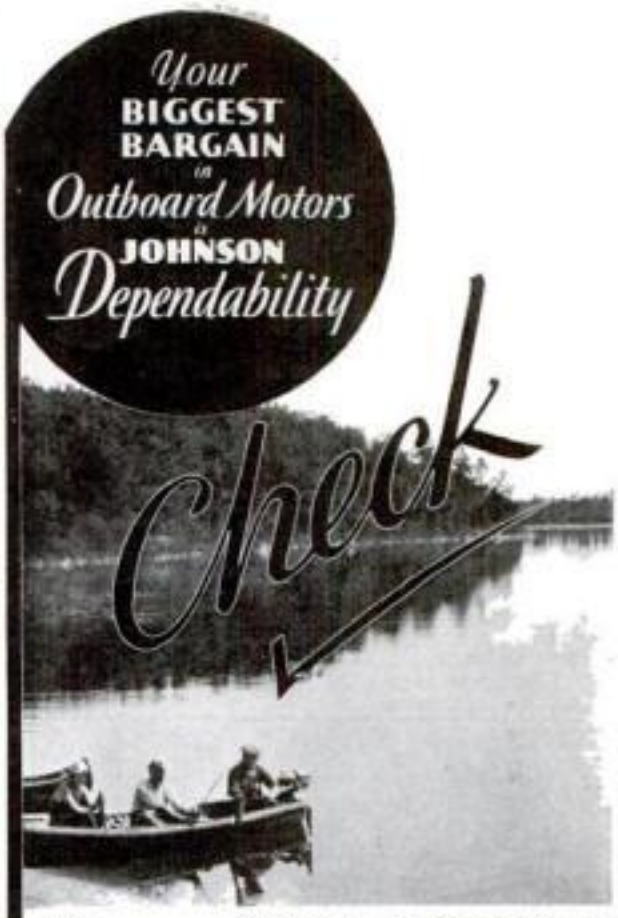
Note: This offer is made only to readers in the United States.



These *SEA-HORSE* REFINEMENTS

PARALLEL TWIN CYLINDERS, fire alternately giving *SMOOTH* flow of power. (Exclusive.)

UNDERWATER EXHAUST, water cooled, quieter. *COMBINED* with full pivot steering.

FULL PIVOT STEERING, to start or steer in ANY direction with full power. (Exclusive.)

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Please send SEA-HORSE Handy Chart—giving complete specifications of entire line of 1932 Johnson motors.

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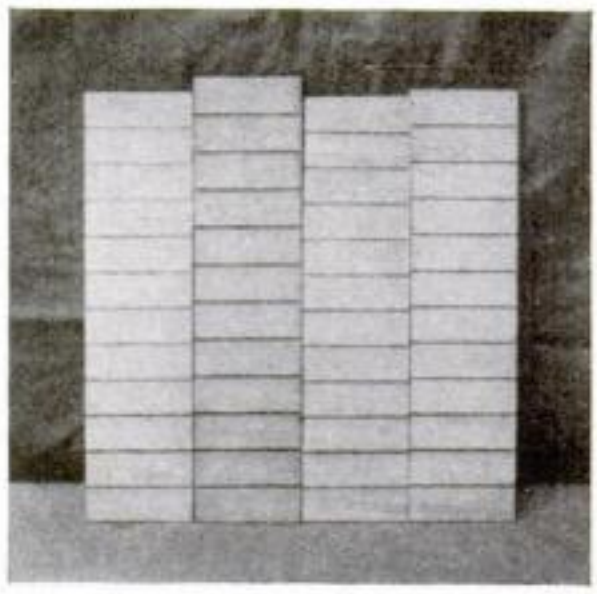
HOW TO GUARD AGAINST CRACKS IN WOODWORK

MANY an amateur woodworker has constructed an elaborate piece of furniture in a none-too-dry basement shop and then been surprised at the way in which the joints opened and cracks developed after his handiwork had been exposed for a time to the dry artificial heat of the living rooms. It is possible to plan the construction so that changes in the moisture content of the wood will not cause such serious defects, but the beginner is not likely to appreciate how necessary this precaution is until he has learned by sad experience.

To demonstrate what moisture does to wood, a clear white pine board 12 in. square



These four pieces show the extent to which a 12 in. wide board will shrink and expand

was marked with shallow cuts 1 in. apart made on a circular saw parallel with the length of the grain. Then the board was cut into four pieces, each 3 in. long.

The piece shown at the left above was kept in its air-dried state and remained exactly 12 in. wide. The second piece was soaked for eighteen hours in warm water and expanded to 12 31/64 in. wide. The third piece was dried in an oven for eighteen hours and shrank to 11 27/32 in. wide. The fourth piece was kept for eighteen hours in a cool, slightly damp cellar and expanded to 12⅛ in. wide. In the direction of the length of the grain, the change was so slight as to be immaterial.

This makes it clear why a skillful furniture builder is so careful to use dry wood of uniform quality, why he fastens wide pieces in such a way that they can expand and contract within limits without cracking open at the joints, and also why he applies a protective finish to his work as soon as possible after the entire job has been completed.—CHARLES A. KING.

DRILLS KEPT HANDY IN TAP AND DIE BOX

MOST machine screw tap and die set boxes are made of two boards, the cover being solid or cut out very little. By drilling several ⅜-in. holes into the end of the cover, a convenient container is made for a special set of tap-size drills. The holes should be fitted with corks. The cost of the extra drills is small and the proper size drill is always available when it is needed.—CHARLES M. BOOTH.

A BEAUTIFUL NEW CIGARETTE BOX

(Continued from page 92)

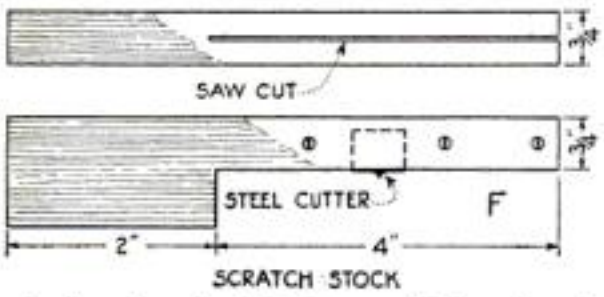
as in ordinary turning on centers. Lay off the length ($2^{15}/_{16}$ in.) and cut off the surplus with a parting tool. Now remove the dead center and cut a 1/16 in. recess in the bottom as shown at *B*. The box then will always stand well. Smooth with sandpaper.

The box is now removed from the faceplate. In its place a piece of softwood such as white pine, about 1½ in. thick and at least 5 in. in diameter, is fastened to the faceplate and turned. A recess about ¼ in. deep and of exactly the same diameter as the box is cut in the softwood, and the bottom of the box inserted therein. It must fit very tightly. This operation is called chucking.

When this has been done correctly, the box will be perfectly centered and can be hollowed out without fear of coming loose. Use a round-nose chisel and a skew chisel for hollowing out the box, and test the diameter of the hole with a pair of inside calipers. Smooth the inside of the box with sandpaper; then cut the recess in the edge for the lid as shown at *C*.

THE lid is made of a piece of stock about 1⅜ in. thick and 3¾ in. square. Mark a circle 3¾ in. in diameter on the face, saw off the sharp corners, and fasten a screw chuck in the center of the piece. Turn the outside of the lid as shown at *D*, then chuck it as shown at *E*. The lid may now be hollowed out and recessed to fit over the lower part of the box. It should fit rather loosely, so that it can be lifted off the box with one hand.

The lower part of the box may be decorated in various ways. It may be inlaid, reeded, or planed so that a number of flat sides or facets are produced. The method chosen here is reeding. Take a narrow strip of paper about ¼ in. wide and wrap it around the box. Cut it so that the two ends just meet and divide it into twelve equal parts. Wrap it around the box again

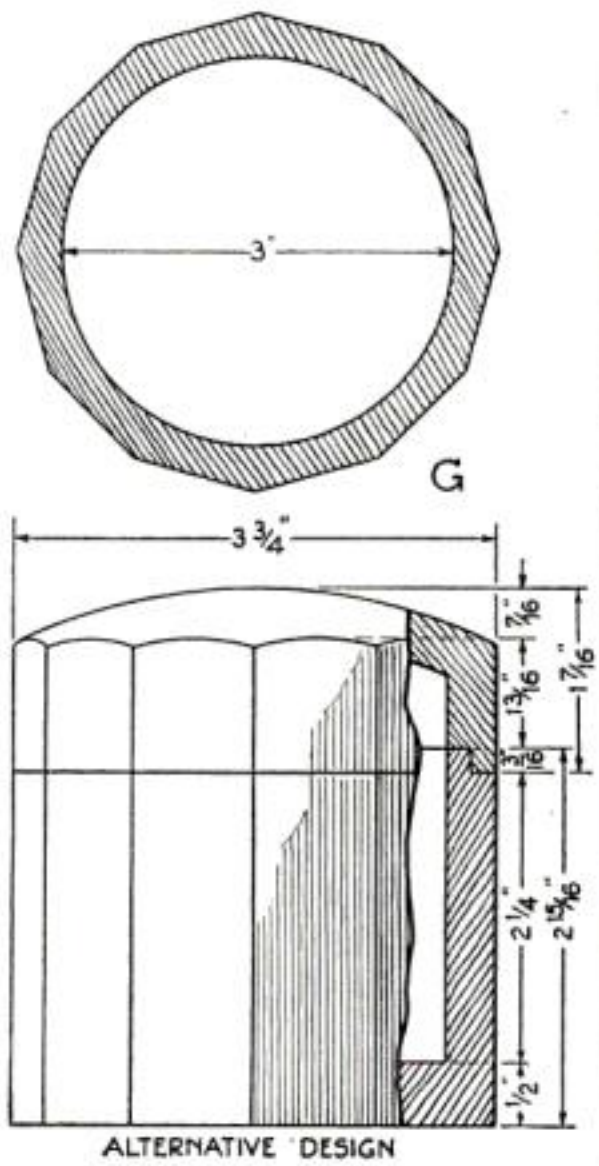


SCRATCH STOCK

A short length of hack saw blade, shaped as shown, forms the scratch stock cutter

so that two of the division lines coincide with the joint between the two pieces of wood from which the box was made. Lay off the twelve divisions on the box. Then stand it on a flat surface and draw vertical lines with the aid of a steel square at each division mark. The reeds may now be cut with a veining tool or with an ordinary ½-in. paring chisel, the box being held horizontally between the jaws of a vise. Smooth with scraper and sandpaper.

A more accurate way to cut the reeds is with a scratch stock, which consists of a piece of steel fastened in a hardwood holder as shown at *F*. A piece of a broken saw blade may be filed or ground on an emery wheel to the desired shape. As illustrated in one of the photographs, an open box is made into which the turned body of the cigarette container fits rather closely. While shaping a reed with the scratch stock, the turning is held securely



ALTERNATIVE DESIGN

For those desiring to make a simpler cigarette box, the above design is suggested

with a couple of small wooden wedges.

If a fine hard wood has been used, the finish may be merely two or three coats of white shellac rubbed down with steel wool and powdered pumice stone and oil. Mahogany, however, may be given a darker color by staining it before applying the shellac. The box may also be made of less expensive woods such as maple or birch. In this case the reeded part may be silvered and the edges of the lid given a coat of black lacquer.

For those who wish to make a somewhat simpler cigarette box, an alternative design is suggested at *G* in the drawings.

USING WATER COLORS ON GLOSSY PHOTOGRAPHS

IT IS difficult to color photographic prints with water colors because of the high gloss, but this can be remedied with a little magnesium carbonate—purchased at any drug store for a few cents. Dust it on the print and then wipe it off with a piece of clean cloth or cotton, and the water colors will go on readily. Uncolored greeting cards and other cards that seem greasy from the printer's ink can be successfully prepared for liquid colors by this same method. And if magnesium carbonate is not available, talcum powder will serve the same purpose.—V. M. CRIDER.

A definite program for getting ahead financially will be found on page four of this issue

ROCK PICTURES TAUGHT MAN A B C's

(Continued from page 38)

Chinese picture writing, we have to go back to their earlier stages to recognize their origin. Thus the question mark developed from the first and last letters of the Latin word *questio,* meaning question. In ancient manuscripts, you will find it in the form of a capital Q placed above a small letter o. The exclamation point stems from the Latin word *io,* meaning joy, and originally was used as a capital I placed above a small o. The dollar sign probably was adapted from the figure 8, denoting a "piece of eight," or eight reales, a Spanish coin worth one dollar. The pound sterling sign merely is the initial of the Latin word *libra,* meaning pound, and the pound-weight sign consists of the first and third letters of the same word. As for the plus and minus signs, they were the arbitrary inventions of Leonardo da Vinci, the great fifteenth century Florentine artist and scientist.

MR. MOK: All this is news to me!

DR. WISSLER: I thought it would interest you. However, those signs are not the only evidences of picture writing in our modern script. Several letters of our alphabet can be traced to the hieroglyphics of the ancients. I will show you that after a bit. First, I want to tell you a little more about how picture writing developed. As I have said, the oldest kind is the Egyptian, which goes back to at least 4,000 B.C. Then came the Babylonian and the related Sumerian, dating from about 3,800 B.C., and finally the Chinese, which originated about 3,000 B.C. They are believed to have influenced one another, but just how is not quite clear as yet.

MR. MOK: What was Babylonian and Sumerian writing like?

DR. WISSLER: This is known as cuneiform, or wedge-shaped, writing because of the peculiar design of the hieroglyphics. Though derived from pictures, like the Egyptian, they changed so radically in the course of time that it is absolutely impossible to recognize images of familiar objects in them.

MR. MOK: Can anyone read ancient Babylonian?

DR. WISSLER: Now some scholars can, but they have been able to do it only a comparatively short while. Like Egyptian hieroglyphics, it remained a closed book for centuries until somebody found the key to the mystery.

MR. MOK: Who discovered it?

DR. WISSLER: Curiously enough, another young army officer and archeologist, but this time an Englishman, Sir Henry Rawlinson. His discovery was very different from that of Boussard, who found the Rosetta stone by accident. Rawlinson's achievement was the result of four years of painstaking study of an inscription in wedge-shaped characters at which people had gazed in wonder for more than 2,000 years, and which several scholars before him vainly had tried to decipher. It is carved on the face of a rock rising to a height of 1,600 feet near Bihistun, in northwestern Persia. There it was, for all the world to see, but until 1847, when Rawlinson tackled the translation, nobody had the slightest idea what it meant.

MR. MOK: What *did* it mean?

DR. WISSLER: It proved to be an advertisement; probably the first ever written.

MR. MOK: An advertisement?

DR. WISSLER: Yes. The "copy," in glowing terms, told the then known world about the fame and power of no less a personage than Darius the Great, ruler of the Persian Empire from 521 to 485 B.C. It was he who selected the cliff as an everlasting billboard for his personal publicity, and at his command the legend was cut into it in Persian, Medic (the language of the Medes), and Babylonian. Rawlinson, because of his profound knowledge of ancient Persian, to which Medic is related, was able to decipher the Babylonian. But even so, it was no child's play. It took him an entire year to translate the first two paragraphs! Three years later, in 1851, he finished the job, which still is considered the greatest single feat in archeology. Since then, hundreds of Babylonian inscriptions have been deciphered. Among them were some carved on stone tablets found by travelers in Persia as early as 1472. Their translation, only completed within the last few years, was of great interest to scientists and created a stir in the religious world besides.

MR. MOK: Why?

DR. WISSLER: One of those tablets told of the Flood as having occurred not 4,000, but 36,000 years ago! Another turned out to be the story of the Creation, and fixed the time at half a million years before that! Still another gave Noah a Sumerian instead of a Hebrew name, and related how he and Adam together had eaten the forbidden fruit!

MR. MOK: The various kinds of picture writing you have told me about all developed in the Old World. What of America?

DR. WISSLER: On this side of the Atlantic, picture writing, like everything else, originated much later, though probably in independent fashion. The picture writing of the Mayas (P.S.M., May '32, p. 15) has been traced back to about 600 B.C., and that of the Aztecs to A.D. 1100. They may have started to write earlier, but so far nothing has been found to prove it. Experts are just beginning to decipher the Mayan hieroglyphics, and I assure you it is a scholarly stunt of the first magnitude. The difficulty is that, in the case of the Mayan script, no equivalent of the Rosetta stone has been discovered.

MR. MOK: How did picture writing change to alphabetic writing?

DR. WISSLER: To understand that thoroughly, you must realize that the two are totally different methods of solving the same problem. In picture writing, the images, no matter how abbreviated or distorted they may become, represent objects visually, such as a picture of a cow for the spoken word "cow." The alphabet, on the other hand, developed from phonetic, or sound writing. Phonetic writing also began by using pictures, *but it did so not to represent the objects themselves, but the sounds of their names. In other words, it is a system of writing in sound pictures.*

MR. MOK: I am afraid I don't quite understand that.

DR. WISSLER: Let me explain. Suppose we had no writing of any kind. We then would start by depicting objects by means of images, just as the ancients did. If, for example, we wanted to set down the spoken word "eye," we would draw a picture of an eye. Similarly, if we wished to write the word "can," we would draw a picture of a can or a pitcher. Is that clear?

MR. MOK: Perfectly.

DR. WISSLER: Now, suppose that one fine day, in a picture letter to a friend, I should want to write down the words "I can," meaning I am able to. I would draw a picture of an eye, followed by a picture of a can or a pitcher. That would be a simple form of phonetic, or sound writing. The pictures of the eye and the can would no longer stand for the objects themselves, but for their sounds. Do you understand?

MR. MOK: Quite. *(Continued on page 113)*

ROCK PICTURES TAUGHT MAN HIS A B C's

(Continued from page 112)

DR. WISSLER: It is what children do when playing the old game of riddles called "rebus." One boy, for instance, will draw a picture of a pitcher, followed by a picture of a man shooting another to death, and finally a picture of a date palm. "Read this," he tells his playmate. The other boy, after studying it a bit, solves the puzzle. "I have it!" he cries. "You wrote 'candidate' (can—die—date)!"

MR. MOK: You mean, then, that sound writing began like the picture puzzles in this rebus game?

DR. WISSLER: Absolutely. A striking example has been preserved in an ancient Aztec manuscript, dating from the time when the Spanish invaders began to convert this race to Christianity. The writer wished to put down the words *pater noster,* literally "Our Father," the Latin title of the Lord's Prayer. The Aztecs, in those days, still used picture writing, though they had begun to spell the names of persons and places rebus fashion. But how to depict *pater noster?* Our author found a way out. He drew a picture of a flag, the Aztec word for which is "pa;" a picture of a stone, which is "te" in Aztec; a picture of a prickly pear, called "noch" in that language; and again a picture of a stone, or "te." Together, this spells "patenochte." Thus he approximated *pater noster* in sound pictures.

MR. MOK: When did people start using sound writing; I mean, in the Old World?

DR. WISSLER: That is hard to say, because it did not begin at any definite time. There was a long transition period in Egypt and also in China during which sound characters crept into picture writing. In advanced Egyptian and Chinese writing there are quite a number of sound pictures sprinkled among the "visual" pictures. True phonetic writing; that is, a system in which nothing except sound symbols was used, is believed to have been developed from the later Egyptian hieroglyphics by some Semitic people; probably the ancestors of the Canaanites.

MR. MOK: And how about the alphabet?

DR. WISSLER: That, as I said, was a direct outgrowth of phonetic writing. It was devised when someone got tired of drawing all these involved sound pictures and decided the time had come for a drastic short cut. His was a deliberate invention, just as much as that of our own modern stenography. This chap revolutionized the whole business of writing.

MR. MOK: Why do you say he revolutionized it?

DR. WISSLER: Because he designed definite symbols for the relatively few sounds made by all human beings in speaking, no matter what their language, to replace the sound pictures of the infinite number of objects and ideas a person might have to describe and express in a lifetime. You should be particularly grateful to this unknown genius. Imagine being a magazine writer in the old picture-writing days! It is because of him you are dealing with only twenty-six letters instead of with a multitude of hieroglyphics. In later Egyptian, there were 1,700 of them!

MR. MOK: Since you put it that way, I am properly thankful. But what makes you so sure this one man deserves all the credit?

DR. WISSLER: A wealth of evidence shows that *the alphabet was invented only once. All alphabets, ancient and modern, are adaptations of that one.* And what an invention it was! Has it ever occurred to you that everything we know is locked up in this code of twenty-odd little (Continued on page 114)

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ROCK PICTURES TAUGHT MAN A B C's

(Continued from page 113)

marks? It is the open sesame to civilization. All history; the great thoughts of the scientists, philosophers, writers, and poets of the ages; in fact, the sum total of human wisdom and knowledge has been set forth in hundreds of thousands of books, in millions upon millions of words—but only in twenty-six letters! As I told you in the beginning of our talk, the oldest example of alphabetic writing discovered so far is a brief fragment on a piece of Canaanite pottery jar found in Palestine a few months ago. It was unearthed, together with other Canaanite treasures, by Dr. Elihu Grant, of Haverford College, near Philadelphia, Pa. Experts headed by Prof. Romain Butin, of the Catholic University in Washington, D. C., translated the few characters as "Children of," probably part of "Children of Israel." They placed the age of the scrap of earthenware at 4,000 years, showing the Canaanites used the alphabet that long ago. But that was not all. The discovery enabled them to determine the age and origin of other, previously found, samples of alphabetic writing.

MR. MOK: What were they?

DR. WISSLER: In 1904, Sir Flinders Petrie, famous British archeologist, found a number of inscribed stone tablets in Sinai, which lies between Egypt and the northern part of Arabia, just east of Suez at the head of the Red Sea. For twenty-seven years, scientists disagreed violently about the meaning of the inscriptions. Some even believed the stones were the original law tablets of Moses. The argument finally was settled last year, when Prof. Martin Sprengling, of the University of Chicago, finished the first complete translation (P.S.M., Nov. '31, p. 48). Most of the inscriptions he deciphered as prayers to Balaat, an ancient Semitic goddess. This fact, of course, proved they antedated Moses. One of the inscriptions, according to Dr. Sprengling, was a message written by an Arab foreman of a copper mine, and it was his theory that this fellow may have invented the alphabet about 1,900 B.C. This seems not to be the case. Prof. Butin and his associates compared the Sinai inscriptions with Dr. Grant's older sample of Canaanite writing, and found the characters to be about the same. Before the age of the Petrie and Grant finds had been established, the oldest known alphabetic writing was that on the Moabite stone found in 1868 in the vicinity of the Dead Sea by a German missionary named Klein, and now in the Louvre Museum, in Paris. The Moabites, by the way, were a Semitic people believed to have been the descendants of Lot, the gentleman in the Old Testament story whose wife was turned into a pillar of salt. This tablet dates from about 1,000 B.C., and for years was considered the oldest example of alphabetic writing in existence. So, you see, the age of the alphabet, within the last year, has been pushed back about 1,000 years. Only the other day, Prof. John Garstang, a British archeologist, made a discovery in Egypt that may throw further light on the history of alphabetic writing.

MR. MOK: What did he find?

DR. WISSLER: Some ancient tablets which he has deciphered as messages from the Canaanites to the Pharaoh of Egypt, asking him to help them keep the Israelites out of the Promised Land.

MR. MOK: Did the first alphabets have twenty-six letters like ours?

DR. WISSLER: No, they had fewer letters, because they had no characters for the five vowels. The ancient Hebrew alphabet, for example, had twenty-two letters; the extra consonant was a special symbol for the sound "sh." There are, to this day, no vowels in the Hebrew prayerbooks that are used in the synagogues; and modern Semitic languages, also, lack the equivalents of our letters a, e, i, o, and u. This was another shorthand trick; one form of modern stenography, the Pitman system, uses the same short cut. Now, the old Canaanite and Hebrew alphabets were carried around the Mediterranean countries by the Phoenicians, a later Semitic people who, as you know, were great traders. That is the reason it was believed for a long time that they were the originators of the alphabet. We know now that they were nothing of the kind; they merely adapted it and spread its use.

DR. WISSLER: The Greeks. Theirs was the first complete alphabet. They took over the Phoenician characters between 1,000 and 600 B.C. Aside from supplying the vowels, they changed the alphabet in several ways. Among other things, they reversed it.

MR. MOK: What do you mean by that?

DR. WISSLER: All Semitic writing reads from right to left. The Greeks were the first to write and read from left to right, as we do. In the five centuries preceding the Christian era, various Italian tribes, notably the Etruscans, adopted and changed the Greek alphabet. It is from them that the Romans learned it, and it is the Roman, or Latin, version of the alphabet which we have inherited, virtually without change.

MR. MOK: You said you would explain how some of the letters of the alphabet can be shown to have developed from picture writing?

DR. WISSLER: Right. Take, for example, our capital A. The corresponding letter in Hebrew is called *aleph*. Now, the word *aleph* in Hebrew also means "ox." In Greek, the letter A is called *alpha*, but this, mind you, is only the name of the letter, and not the Greek word for ox. In ancient Egyptian picture writing, the head of an ox was the symbol for that word. The theory is that, when the alphabet was invented, this symbol, greatly simplified, was selected to represent the letter A, which still resembles an inverted ox-head. You see, in the beginning, each letter was named for a word beginning with it, and at the same time the hieroglyphic for that word was simplified into that letter. Thus the letter B, in Hebrew, is called *beth*, meaning "house," and the character originally was a simplified hieroglyphic picture of a house; the letter G, in Hebrew, is *gimel*, meaning "camel," and the letter was developed from the hieroglyphic for camel.

MR. MOK: You have told me how our early ancestors wrote, but not what they wrote with. What kind of writing materials did they use?

DR. WISSLER: The oldest records are inscribed upon stone tablets, but the ancient Egyptians already used papyrus, a kind of paper made from the papyrus plant. The Romans wrote their official proclamations on oak boards covered with wax; and their messages, records, and books on parchment, which is made from sheep and goat skin. They used feather pens; as a matter of fact, our word "pen" comes from the Latin *penna*, meaning feather.

MR. MOK: And how about printing?

DR. WISSLER: As you know, printing in Europe began in the fifteenth century. Gutenberg printed his first Bible in 1438. The typewriter on which you will write out this interview was invented by an American named Sholes in 1868, and in 1890 Mergenthaler, also an American, invented the linotype machine on which it will be set in type.

PROVE WORLD ALIVE WITH WORMS

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In shipping nemas by air mail a bottle full of them is placed in the metal case of a vacuum bottle which is then filled with dry ice

vegetation a few shreds of moss, nemas were discovered in great numbers. Most of them belonged to species commonly found in the Low Countries, Belgium and Holland, yet they were thriving in an altitude of more than 14,000 feet above sea level!

The ocean bottom off the Bahama Islands recently served as the stage setting for an interesting act in the drama of nematology. There the Atlantic floor is composed of a white "mud" called drewite. This was formerly thought to be of coral origin, but it is now known that nemas are a link in the chain of its manufacture.

An international expedition, organized to study drewite and related matters in the Bahamas, wanted to know if nemas lived in this strange white mud. Six small sample bottles of it were sent to Dr. Cobb's laboratory at Washington for analysis. There it was found that the drewite in these small bottles contained hundreds of nemas.

Among this lot of strange wormlike creatures brought up from the depths of the tropic sea, there were about 150 hitherto unknown species. Many of these Bahama nemas were seen under the microscope to be thickly covered with a microscopic form of life of the order of bacteria. So thick were these bacteria in some cases that the nemas appeared to be covered with fur. These infinitesimal creatures are also believed to be playing a part in the manufacture of drewite.

A PARTNERSHIP like that between the nemas and these bacteria is known as "commensalism"—each of two closely associated life forms helping the other. In some cases, the nemas actually feed upon certain of the microscopic creatures. This process, Dr. Cobb explained, is not unlike that which occurs in decay of vegetable matter in the soil. There, tiny organisms responsible for the conversion of vegetable matter into humus are devoured by nemas. The latter secure their nourishment from a secretion of the microörganisms, which are then passed back into the soil in living condition. The nemas found in drewite seem to perform a similar function.

A few years ago, Dr. Cobb demonstrated that live nemas could be shipped in quantities anywhere in the country at moderate cost. Nemas found in stagnant marine mud at Wood's Hole, Mass., were shipped by air mail in vacuum bottles, packed in dry ice.

About the same *(Continued on page 116)*

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time, textbooks were being revised, and other zoological publications, treating of nemas in the light of new discoveries, were brought out. An immediate effect of these activities was a realization of the importance of nemas to man and his agricultural works. Nemas were given a separate phylum, or division of animal life, to themselves, like mammals and fishes.

Shortly afterward, the Department of Agriculture established at Washington a nematological laboratory. Dr. Cobb was placed in charge of it. Meanwhile some of the larger private agricultural interests, like the sugar beet and cattle industries, began their own studies of nematology.

Dr. Cobb showed me over the laboratory where much work in nematology is being done. When a new nema is received at the laboratory, its physical characteristics are carefully compared with those of already identified species. For before a new species can be given a name, it must be definitely proved that it is different from all previously named nemas.

I WAS shown the apparatus by means of which nemas are extracted from earth. It operates on the principle that nemas are heavier than water but lighter than soil. Earth containing nemas is put into a tall rotating cylinder. Water is run into this at a rate just sufficient to overcome the tendency of nemas to sink, but not enough to prevent the earth from sinking. Thus nemas are carried to the top of the cylinder, where they are drawn off, with the overflowing water, into glass vessels. Sediment from these is strained through sieves, leaving the nemas behind.

In the laboratory a number of artists are engaged in making pen-and-ink drawings of nemas. These are used for illustrations in textbooks and bulletins, for photomicrographs of nemas do not reproduce well in print. "Studios" in which the nemas sit for their portraits are strangely equipped affairs. Artists making the pictures peer at their subjects through microscopes. These are mounted at table height on heavy steel frames, independent of the framing of the building in which the laboratory is located. Thus vibrations caused by traffic on near-by streets do not blur the nema's image or joggle the hands of the artists making delicate drawings of the creatures.

TO THE right of each microscope is a camera lucida, a prismatic device used in making enlarged copies of any object. The paper on which the nema is being drawn is placed so that it is in the field of the microscope. The camera lucida is arranged so that it throws the magnified image of the nema directly on the paper. So it is only necessary for the artist to trace the nema, since object and drawing can both be seen through the eyepiece of the instrument. An adjustable headrest over each microscope enables the artist always to have his eyes in the same relation to the work. Each of these strange little studios is screened by black shades that can be raised or lowered by a foot treadle while the artist is at work, without interrupting the work.

I was shown specimens of nema-infested plants and vegetables that constantly are being received at this laboratory from all parts of this country and from many foreign lands. Many of them were familiar garden products, such as beets, carrots, or potatoes. There also were samples of cotton and tobacco plant roots infested with nemas. For this strange life form plays no favorites when it comes to preying on living things. From the vast wheat and sugarbeet fields of the West, the great plantations of the South, to the smallest suburban kitchen or flower garden, they carry on their destructive work. And these creatures are close blood relations of the nemas found near the Poles and in the deeps of tropic seas.

As an example of how some nemas may attack flowers, consider what they do to the sweet pea. It is the experience of many small suburban gardeners that this flower suffers from what is called the root-knot disease. At first the plants seem to be doing well, but in spite of unceasing care and attention it is soon evident that something is wrong. Finally the plants die for no apparent reason. If the gardener takes the trouble to uproot one of the plants he will find its roots grown into knots and galls, from which this plant disease takes its name. If one of these knots is cut open, the gardener will find that it harbors a nema commonly known as the gall nema.

Wheat raisers often find themselves plagued by *Tylenchus tritici,* a nema that specializes in preying on cereal crops. This creature literally grows up with the plants. It usually makes its appearance in fields through the agency of seeds infested with its eggs. When these seeds are planted *Tylenchus* larvae are hatched and make their way up through the stalks as they grow. They reach maturity at about the same time as the wheat blossoms, depositing their eggs in seeds in the blossoms. These fall to the ground, and eventually new plants spring up, but their stalks are also infested, as were the original seeds, and the vicious circle is complete.

TERRIBLE damage has been done in sugar beet fields by the activities of the sugar-beet nema. This species attacks the beets through their roots, the result being a stunted beet with many extra root shoots.

For the control of nemas that prey on growing things no satisfactory chemical or mechanical methods have yet been devised. They can, however, be fought with ground sanitation or crop rotation. The latter method has been adopted with success by sugar-beet raisers. It was discovered that sugar-beet nemas subsisted largely on beets alone, and that they did not like other plants. Therefore, the planting of other crops on the beet fields after nemas have made their appearance tends to starve them out. It is a long process, though, and often means that three or four years must elapse between successive sugar-beet crops on fields that have shown heavy infestation.

PLANTING nothing but seeds known to be free of nema eggs is one way of fighting nemas that prey on wheat crops. These nemas are the hardiest of a hardy order of animal life. Wheat seeds in storage as long as twenty years have been found by research workers to be infested with live nema eggs! The seeds were dry and withered, and it was thought any infestation with which they had become afflicted was dead. Yet when the seeds were moistened, it was seen that the eggs were alive.

Sheep, cattle, swine, and dogs are some of the larger animals that suffer from nemic infestations. Among the more important of these is the *Ascaris,* or kidney worm, which preys on swine, stunting their growth and sometimes killing them. These creatures are found chiefly in the South. Then there is the stomach or nodular worm, causing what stockmen call an "unthrifty" condition of sheep, which gives them a poor, mean appearance, and frequently kills them. Trichinosis, a disease contracted by people who have eaten insuffi- *(Continued on page 117)*

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PROVE WORLD ALIVE WITH WORMS

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ciently cooked pork, originates with nemas infesting the animal from which the meat was taken.

I asked Dr. Cobb how livestock became infested with nemas. He replied that in practically every case, either directly or indirectly, it was through the ground. As the New England grasshoppers swallowed nema eggs by eating leaves of the long-leaved plantain, so cattle, sheep, or horses may gulp down nema eggs that have been laid on grass blades in fields or pastures. Sometimes animals become infested through what are known as intermediate hosts. Earthworms or beetles may become infested with nemas, and may be accidentally swallowed by grazing animals while cropping grass.

In 1902, Charles Wardell Stiles discovered a form of nema named *Necator americanus* —literally, the American murderer—better known as the hookworm. It is about one third of an inch long and scarcely thicker than a small hairpin. Its larvae, living originally in the ground, usually enter the human body through the skin of the hands or feet, but sometimes through the mouth in polluted drinking water or spoiled food or in earth clinging to the vegetable he eats.

ONCE inside its victim, the hookworm attaches itself to the wall of the small intestine and raises a numerous brood. One patient was found to harbor as many as 5,000 hookworms! The creatures live on the sufferer's blood, and so cause anemia, hemorrhages, and heart trouble. The digestive organs become affected and finally the patient, emaciated in appearance, loses his mental and physical energy and sinks into a lethargy that robs him of all interest in life.

In the United States, hookworm disease is confined chiefly to the river valleys of the South Atlantic and Gulf States, and the mining districts of the West Coast. It is believed to have been introduced into this country by Negro slaves.

So far, three drugs have been found to be effective weapons in the fight on this terrible little creature. They are thymol, oil of chenopodium, and carbon tetrachloride. The last-named is the newest and most effective of the three. It was developed by Dr. Morris Hall, of the Bureau of Animal Industry of the United States Department of Agriculture. Use of these drugs, together with preventive sanitary measures—such as purifying the water supply and teaching natives of affected areas not to go barefoot—has reduced the number of hookworm cases in some parts of the South by more than fifty percent during the past few years.

THUS far, no chemical methods as satisfactory as those used in fighting hookworm have been developed to control nemas that attack herds and crops. Still, nematologists are not discouraged. They feel their science is making gratifying progress. Nematology has been freed from an accumulation of errors. The importance of nemas as a separate division of animal life finally has been recognized by many of the modern scientific inquirers.

Though it now stands on its own feet, nematology still is a new science. Nematologists realize that they are standing with their hands on the latch of a door that may swing open at any moment and reveal to them new and important secrets of nature. Such secrets hitherto have been locked within the earth beneath your feet, but when they are disclosed at last it is believed they may be translated into means of creating an era of better growing things in both the animal and vegetable kingdoms.

RAISING GAME BIRDS FOR PROFIT

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are used. Pheasants are reared in fields covered by a rank growth of clover intermixed with other plants. Swaths are cut in the vegetation and hatching coops placed in these. Young birds find shelter and food in the rank growth of clover and grass.

The life history of a captive baby pheasant begins either in an incubator or under the feathers of a broody hen. It is to supply these hens that a poultry section is generally a part of a pheasant farm.

Eggs are collected from laying pheasants and placed in a dry, cool cellar to season for ten to twelve days. This seasoning results in more even hatching, and enables enough eggs to be collected for a large setting.

The mother hen must remain on the eggs from twenty-three to twenty-seven days. From fifteen to eighteen eggs are placed in a single hatching coop. Constant vigil is kept to see that the mother does not develop disease or a crop of lice.

For twenty-four hours after pipping, the hen and chicks are left alone. Next, they are removed to the rearing field, where the young are confined in a run near the coop for three days. Then they are given more freedom. When four weeks old, their flight feathers are clipped for the first time. At the age of seven weeks, the birds to be kept for breeding stock are again trapped and clipped. Those to be used on in restocking game preserves are not clipped, but are placed in covered pens. Young birds being kept for next year's breeders must be clipped repeatedly.

So far, the use of incubators has resulted in a lower percentage of birds from a given number of eggs than if hens were used, but the lower cost of artificial incubation makes the system attractive. Also, there is less loss from disease. Electric hatching as used at the Massachusetts State Game farm is from sixty to seventy-five percent efficient, as compared with eighty or ninety for hens.

If pheasants other than ringnecks are raised, they are kept separate to prevent fighting. Also, they must be handled as economically as possible because the market for them is limited. One fancy pheasant specialist, who has bred sixteen different species, keeps his birds penned up at all times.

Hungarian partridges are among the other game birds that can be raised successfully in pens. They are descendants of imported birds. It has been found that these birds, like nearly all others, are superior for breeding purposes when raised "by hand."

Native grouse are too valuable to be reared in uncovered pens. They are treated much like quail. The young birds have to be kept in the shade because strong sunlight will kill them. The wild turkey is another bird that can be raised by hand. It is difficult, however, to obtain breeders that are of one hundred percent wild stock.

It is evident that game bird raising has come to stay, and that the demand probably will become greater as restocking is undertaken on a wider scale, and the chicken, as an item of food, is more generally replaced by game birds. There undoubtedly is opportunity for reaping rich reward, providing the game-bird raiser is willing to work intelligently and energetically and is not discouraged by epidemics or other temporary misfortune.

STUDY SEA TO PREDICT WEATHER

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heavier air, called the monsoon, pours in from the Persian Gulf.

If this air were colored brown, one could see the monsoon winds rushing toward the tip of India. There the stream divides, part rolling up the east coast, the rest up the west coast. Then the monsoon air stream strikes inland, the eastern streams converge again, and the reunited monsoon rises over the Himalaya Mountains, pouring out its rain as it goes.

When winter comes, the monsoon reverses its direction, but drops no water. Instead, it brings cool air to the peninsula. This is the important point: the Indian monsoons carry more rain through the air than any other winds in the world and on Cherrapunji, at the head of a valley in the Himalayan foothills, the monsoons drop more rain than does any other wind anywhere in the world. An open tank at Cherrapunji would be filled to the thirty-five-foot level in a single season!

In the northern hemisphere, warm air flows along the surface of the earth and sea from subtropic regions toward the polar ice fields. It concentrates into warm tongues and continues into the polar regions at upper levels where it cools and returns to lower levels. Thus masses of cooled air accumulate and finally are expelled southward. A succession of cyclonic storms returns to the earth in the form of rain and snow the water that had been evaporated from the sea.

Although the amount of rain that falls in a given area can be measured directly, it is more difficult to determine the evaporation from the sea. Available observations indicate a rate of about 2.7 feet evaporated each year. If science can learn more definitely where and in what quantities this evaporated water will be carried inland during a given year, forecasters may be able to say with greater accuracy where and when it will be delivered on the earth's surface.

Besides making their daily observations at La Jolla, the California scientists are studying the temperature records kept by an instrument installed on the S. S. *Calawaii*, plying between California and Hawaii. Throughout every run, day and night, a pen traces on a revolving cylinder a heat and cold record of the water twenty feet below the surface.

Comparison with the records made at La Jolla have indicated that the temperature movement all the way to Hawaii is in accord with the trend of the inshore record. By taking readings from Japanese and Canadian merchant steamer records, the experts are now trying to extend their data twenty years into the past. By this means they hope to discover long trends in sea temperature of great significance in establishing weather cycles.

From this study of the interlinking elements that govern rainfall and drought, the Scripps Institution scientists have evolved a valuable new method of weather prediction that promises to give accurate forecasts decades in advance.

CAPTURE GIANT PYTHON

A THIRTY-FIVE-FOOT python, largest ever captured, was recently caught by Japanese farmers in the Philippine Islands and shipped to a Tokio museum. The monster serpent is one of the most formidable in captivity. A blow from its head or tail would inflict a serious injury. Such huge snakes are caught with lassos, the reptile's head and tail being stretched out and made fast to trees.

GIANT METAL "EARTH"

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in the mire of a swamp below. By use of a special composition sponge rubber, this swamp is designed so it will heave and quake realistically as the great beasts rock back and forth.

In the construction of the animals and the settings, nearly 1,000 different materials will be employed. The whole display will be fireproof. The grottos will be constructed of concrete. Colored steel wool will represent hanging moss, flaked asbestos will be used for snow and ice, and all foliage will be specially treated to make it noninflammable.

As the spectators descend from the main floor along the winding ramps, they will view creatures that swam in the seas millions of years ago. These mechanical reproductions will be placed behind narrow aquariums so the spectators will see them moving with real live fish swimming in front of them. Waving moss in the water will also help create an illusion of reality.

Lower still, visitors will find mechanical tigers, giraffes, and elephants, representing modern animals, placed in their natural surroundings. All told, there will be more than 150 birds, animals, and fish represented. They will range from prehistoric fish weighing 500 pounds to extinct monsters tipping the scales at more than two tons.

TUMBLING down the center of the lower half of the globe will be a forty-five-foot cascade of ice-water, six feet wide at the top and twenty feet wide at the base. It will cool the atmosphere within the metal globe during the heat of the summer. As the Fair is to last only five months, starting in June, a heating system will be unnecessary. Beneath the cascade, on cakes of imitation ice, Arctic animals—mechanical seals, Polar bears, and walruses—will be placed.

Until a few months ago, such reproductions would have been impossible, because water ruined the papier-mâché which plays an important part in the construction of the mechanical animals. Recently, the experts have developed, as the result of several years' research, a secret chemical solution which makes papier-mâché waterproof.

Practically all the weight of the metal ball will be located in the lower half of the globe. Inside the upper half, a shell of thin copper is to represent the sky. Star-shaped openings will perforate this copper dome and behind them, during periods of darkness, lights will glitter with varying intensity. Not only will the constellations appear in this firmament, but the mysterious "winking" stars, whose light periodically waxes and wanes in intensity, will be represented by means of special dimming rheostats. In three minutes, a twenty-four-hour cycle of light and darkness is to be reproduced.

BEHIND the early-world landscapes which will circle the wall around the main floor, concealed lighting will create the color effects of sunrise, sunset, and twilight. During dusk, the spectators will see pterodactyls, giant winged creatures of prehistoric times, go flapping overhead across the darkened sky, supported by invisible piano wires.

The plot of ground upon which the metal ball is to be erected will measure 150 feet by 150 feet. The base upon which the great globe will rest is to be ten feet high. Besides the entrances and exits, it will contain the main control room from which the lectures will be broadcast to the earphones and where the steam plant and the machinery which operates the elevators will be located.

The cost of constructing the metal globe, which is 100 feet in diameter, and the strange zoo it will contain is expected to be between $750,000 and $1,000,000. The interior will accommodate 1,500 to 2,000 spectators at a time.

Outlaw Radio Stations Run to Earth

(Continued from page 15)

well as code books and firearms, and arrest the operator. If the raid is successful, the rum syndicate's operator will find himself liable to a maximum fine of $5,000, or a maximum sentence of five years. And all that was 2XO will be but a memory.

The law is painfully specific in one regard, however. It says in just so many words that unless an operator of an illegal station is actually caught in the act of transmitting a message, he cannot be held under the law. This means in the case of 2XO that a raid to be successful must be so timed that it corresponds with either the thirteen-minute interval that 2XO is on the air in the afternoon, starting at 1:30, or the thirteen-minute interval it uses in the evening, starting at eight o'clock.

The Government makes its plans accordingly. Putting 2XO and its equipment and operator out of commission might be thought action enough for one day. But the Government intends to go considerably further than that.

WITH 2XO in its possession and the rum syndicate's radio man safely handcuffed, it plans to put one of its crack wireless operators at the key. He will continue the conversations with 2PG, transmitting orders to the syndicate's boats which will lead them directly into the arms of the United States Coast Guard.

This is the sort of grand slam that even the most blasé sleuths in Uncle Sam's service will gloat over. It has been done—not frequently, but often enough to convince the big powers engaged in smuggling that the Government has in its service a few specialists who certainly know their wireless telegraphy, and, equally important, their code.

In preparing to swoop down upon Station 2XO and its operator, the raiding caravan proceeds cautiously to the scene. The cars take separate routes and use the less-frequented highways. Every precaution is brought into play to avoid detection.

As the zero hour approaches the raiders collect in an undercover spot, well shielded from public view, and make ready for the jump-off. Sometimes this spot is more than a mile removed from the illicit station. Sometimes it is within a few hundred feet. Everything depends upon the terrain of the country or the layout of the immediate neighborhood.

In the lead car—the speediest of the lot—sits the radio expert with the field intensity apparatus on his lap. The motor of the car is purring. All that is necessary now are a few signals from 2XO showing that the operator of that station has his finger on the key and is transmitting. Presently the signals arrive and the dash is on.

Occupants of the lead car, first to arrive, burst in upon 2XO and bowl over the operator from his set. His place is immediately taken by the Government's expert, who has previously written out in code the messages he desires to transmit to the ships anchored in line out at sea. If Ship Station 2PG is transmitting in straight language when this expert takes over the key he replies in like manner. Gradually, however, he works into code, asking such questions as "Are you ready?" or "Is reception good?" If the answers are satisfactory and reveal no suspicion, he sends out his first bold message: "Get going and transfer sacks."

Provided the raid is timed correctly 2PG will answer "Okay" and keep up a running stream of messages, reporting the transfer of liquor stage by stage to the high-speed cruisers. Finally there arrives the query which strikes joy to the heart of the Government's operator—"Ready for getaway. Everything clear?" Back goes the order from 2XO, "Waiting. Come on." And then the response from 2PG, "They're off. Good luck."

There are no further communications with 2PG. The Government's radio man does some quick tuning and gets in touch almost immediately with the Coast Guard cutters that are lying in wait, several miles from shore, ready for the tip-off. The information needed to dispatch those cutters at top speed in chase of the rum-running cruisers is imparted in a matter of seconds. The power of 2XO is then cut off, and the job completed so far as the land forces of Uncle Sam are concerned. If the Coast Guard captures its swift-running enemy, that's more glory. If the enemy outdistances them in the chase, the liquor will be dumped.

The captured radio equipment of Station 2XO goes into a United States warehouse to be used as evidence in the trial of the syndicate's operator. This gentleman goes to jail. But he does not stay there for long. The syndicate generously provides bail for him. A wise boy he would be if he were to refuse it, stay behind the bars, and take his medicine. For once the gang has bailed him out or has paid his fine he is in their clutches.

These radio operators for rum syndicates are promised from $100 to $200 a week for their services. They seldom collect more than $50 a week, however, and it doesn't do any good to complain.

In common with other forms of illicit business, the rum empire is well organized. It does not restrict its operations to liquor alone. As profitable sidelines it often deals in the smuggling of narcotics and aliens. One suit case full of narcotics, delivered safely on shore, is equal in value to a ship and its load of liquor. The syndicate plans to land its narcotics first and thus safeguard itself against any possible loss of its ship and wet goods. Aliens desiring to take the easiest way in entering this country are promised a safe landing if they will sign up for three consecutive trips on the rum boats.

In early days, expensive ships of large tonnage were used in the business. Today the boats average as a rule not more than a hundred tons each, and the loss of several of them is no longer a death blow to the syndicate. Riding these light craft at anchor thirty to fifty miles out at sea is an experience that only the hardiest sailors can survive. These vessels often wait at anchor from two weeks to a month or more before they can safely transfer their contraband to cruisers that make the dash for shore.

MODERN in every respect and costly, too, is the radio apparatus used by the syndicates. Transmitters range in power from fifty to more than five hundred watts and are equipped with special aerials which concentrate the radio waves into beams instead of allowing them to scatter. Distances of from 800 to 2,000 miles are penetrated with ease.

As a matter of fact, the syndicates keep in touch with their boats from the port of loading to the positions at which they anchor off the shores of this country. The Bahama Islands, east of Florida, and Nova Scotia, especially in the vicinity of Halifax, are the favorite loading places. The rum runners do not operate directly out of Halifax, however. They use the smaller harbors such as Liverpool, Lunenburg, Shelburne, Meteghan, and Yarmouth.

Of the many tricks employed by the hirelings of the syndicates in evading capture of their expensive radio equipment, the one most frequently used in remote control. On one occasion the Government inspectors were convinced that a certain building housed an apparatus that talked through space to Rum Row. They made a search but failed to uncover the evidence. They returned to the scene and this time inspected the wiring of an innocent-looking short-wave receiver which any amateur might use in tuning in foreign waves.

As this set was moved away from the wall, a wireless key fell from a niche behind the cabinet. Wires were seen to pass through the wall. They were followed and traced to a garage which adjoined the main building. Inspection revealed no radio transmitter in the garage. But in the loft, the detectives found fifteen trunks covered with dust.

They pried open these trunks, one after the other. In the last one they found a complete 500-watt short-wave transmitter. A glass bottle filled with a fire-extinguishing chemical was fastened near the vacuum tubes as a precaution against fire, should the trunk at the bottom of the pile become overheated by the tubes. The person who had devised the ingenious arrangement figured that in such an event the heat would break the glass of the bottle and the liquid would spread out, choking off the blaze. The aerial was under the rafters.

ON ANOTHER hunt, a Government agent noticed a streak of new grass across a stretch of lawn. Curiosity led him to dig down about a foot. His hunch proved correct, for he found a cable. Following it he came to a building near by and at the end discovered a transmitter. The operating key was hidden in another house to which the wires ran under the grass.

Hiding illicit transmitters behind panels or cleverly plastered surfaces which show no traces of tampering is a favorite practice of those who hope to ward off detection. Sometimes the apparatus will be found in steel-barred rooms, with plenty of weapons near at hand, including sawed-off shotguns, revolvers, and occasionally a supply of tear-gas bombs. In making their raids, the Federal men come well prepared with weapons of their own. Although gun battles occur infrequently in their work, they never can tell what the next raid will bring.

During the last sixteen months, these secret service squads have ferreted out and confiscated eighteen hidden stations which were being operated by rum or smuggling syndicates.

Among the men who deciphered the messages flashing from these illegal stations were experts who were aces in the code work of the War Department during the World War. Their training in decoding messages sent by the enemy is now being applied to trapping gangland radio men.

A year ago, great assistance in decoding the messages was obtained when Department of Justice agents raided a house in Highlands, N. J., and confiscated for the first time a criminal radio code book. With this as a start, the code experts are said to have made a perfect record in reading the secret messages which have been intercepted.

W. D. Terrell, director of the radio division of the Department of Commerce, recently estimated that half a hundred unlicensed stations operated by criminal bands are in existence around New York City. Others have been detected along the south Atlantic and Pacific coasts.

So numerous have they become, he says, that their messages are actually crowding the air lanes and interfering with licensed short wave stations, including police networks. The Government's war on these outlaw stations represents an exciting use of science in outwitting the stratagems of organized crime.

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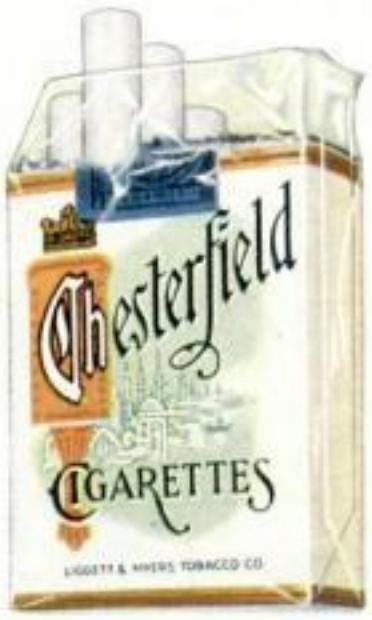

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